St. Joseph Wind Farm Inc.

BowArk Energy Ltd.

BABCOCK & BROWN

St. Joseph Wind Energy Project

Environmental Impact Study Report
Volume 1




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ACRONYMS AND ABBREVIATIONS

CAC	Criteria Air Contaminant
CanWEA	Canadian Wind Energy Association
CEAA	*Canadian Environmental Assessment Act*
CEA Agency	Canadian Environmental Assessment Agency
COSEWIC	Committee On the Status of Endangered Wildlife in Canada
dBA	A-weighted Decibels
DFO	Department of Fisheries and Oceans
DNR	Department of Natural Resources
EA	Environmental Assessment
EC	Environment Canada
EIS	Environmental Impact Study
EISR	Environmental Impact Study Report
EMP	Environmental Management Plan
EMS	Environmental Management System
EPP	Environmental Protection Plan
ERP	Emergency Response Plan
FA	Federal Authority
GHG	Greenhouse Gas
ha	hectare
HADD	Harmful alteration, disruption or destruction (of fish habitat)
HRIA	Heritage Resource Impact Assessment
IC	Industry Canada
IEC	International Electrotechnical Commission
INAC	Indian and Northern Affairs Canada
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
km	kilometre
m	metre
m/s	metres per second
MW	megawatt
N/A	Not available or not applicable
NBC	National Building Code
NRCan	Natural Resources Canada
OHSAS	Occupational Health and Safety Assessment Series
PDD	Project Description Document
PPA	Power Purchase Agreement

RA	Responsible Authority
RM	Rural municipality
RFP	Request for Proposals
rpm	Rotation per minute
SARA	*Species at Risk Act*
SCADA	Supervisory Control & Data Acquisition System
S-rank	Subnational Rank
VEC	Valued Ecosystem Component
WTG	Wind Turbine Generator
WWEA	World Wind Energy Association

1 INTRODUCTION

St. Joseph Wind Farm Inc. is proposing to develop a wind energy project having a maximum of 200 wind turbine generators (WTG), for an installed capacity of 300 MW.

This environmental impact study (EIS) report for the St. Joseph Wind Energy Project, hereafter referred to as "the Project", is being submitted to the Manitoba Conservation Environmental Assessment and Licensing Branch and the Canadian Environmental Assessment Agency to fulfill the requirements with respect to applicable provincial and federal environmental assessment certifications. This application follows the Environmental Impact Statement Guidelines for Screenings of Inland Wind Farms under the *Canadian Environmental Assessment Act*.

1.1 Project Title

The name of the project is the St. Joseph Wind Energy Project.

1.2 Project Proponent

The proponent of this Project is St. Joseph Wind Farm Inc., a registered company in the province of Manitoba. St. Joseph Wind Farm Inc. is wholly owned by Babcock & Brown. BowArk Energy Ltd. ("BowArk") is acting on behalf of St. Joseph Wind Farm Inc. ("St. Joseph Wind Farm") as the primary developer for the Project. Its contact Information is as follows:

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www.bowark.com
www.babcockbrown.com

1.3 Environmental Assessment Team

St. Joseph Wind Farm has retained the services of consulting firms with expertise in wind energy, environmental assessments, archaeology, and engineering. Helimax Energy Inc. ("Helimax") has been retained to lead the environmental assessment effort for this Project. Its contact information is as follows:

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Helimax Energy Inc. (“Helimax”) is an independent wind energy consulting firm. Since its founding in 1998, Helimax has participated in a multitude of wind projects throughout the world, providing engineering, advanced meteorology, environmental and financial analysis services. Moreover, Helimax has recently become the largest North American wind energy firm to be certified ISO 14001:2004 and OHSAS 18001:1999, allowing it to ensure a rigorous level of conformity with respect to the environment and the health and safety of its employees and sub-contractors.

Helimax is composed of a team of over 50 professional meteorologists, technicians, engineers and environmental specialists. Over the years, Helimax has supplied its expertise in 20 countries and 9 provinces across Canada. These mandates include more than 20 environmental impact studies. In Manitoba, Helimax has conducted or is the process of conducting environmental assessment studies for several wind energy projects. Helimax has performed detailed environmental studies of various types for more than 4000 MW of wind energy projects. Overall, Helimax has worked on over 20,000 MW of wind projects in operation or under development.

In September 2007, Helimax formed a strategic partnership with Germanischer Lloyd (GL). GL is a German firm offering a wide range of technical surveillance services in the maritime and industrial sectors, including gas, oil and wind power. GL employs 4100 persons in 176 offices in 76 countries.

More information on Helimax can be found at: www.helimax.com.

1.4 Project Overview and Rationale

1.4.1 Project Overview

Since 2005, BowArk has been investigating the potential for wind energy projects in the province of Manitoba. The St. Joseph area, considered to have a good wind resource potential and meeting criteria such as proximity to transmission lines, suitable lands with compatible uses, manageable environmental impact, etc., was selected for further investigation through the installation of a first meteorological tower (“met tower”).

More thorough development, including site assessments, energy yield estimates, and community consultations have been ongoing for the past two years. With a potential installed capacity of 300 MW, the Project would be capable of meeting the power needs of some 100,000 households.

The Project is located in the vicinity of the town of St. Joseph, approximately 85 km south of Winnipeg, and overlaps the Rural Municipalities of Rhineland and Montcalm. The turbines are distributed over an area of approximately 215 km^2 of agricultural land. The Project location map (Map 1-1 - all maps in Volume 2) shows the general Study Area. According to recent assessments, the site offers an excellent wind resource.

With a current Capital Cost estimated at more than $600M when built to maximum size, the Project will provide reliable clean energy, as well as create specialized regional employment opportunities in renewable energy. The Project can also provide a regional platform for promoting the renewable energy sector throughout Manitoba. It is expected that the Project will create 200 to 300 jobs during the preparation and construction phases and some 15 long-term skilled jobs during the operational phase.

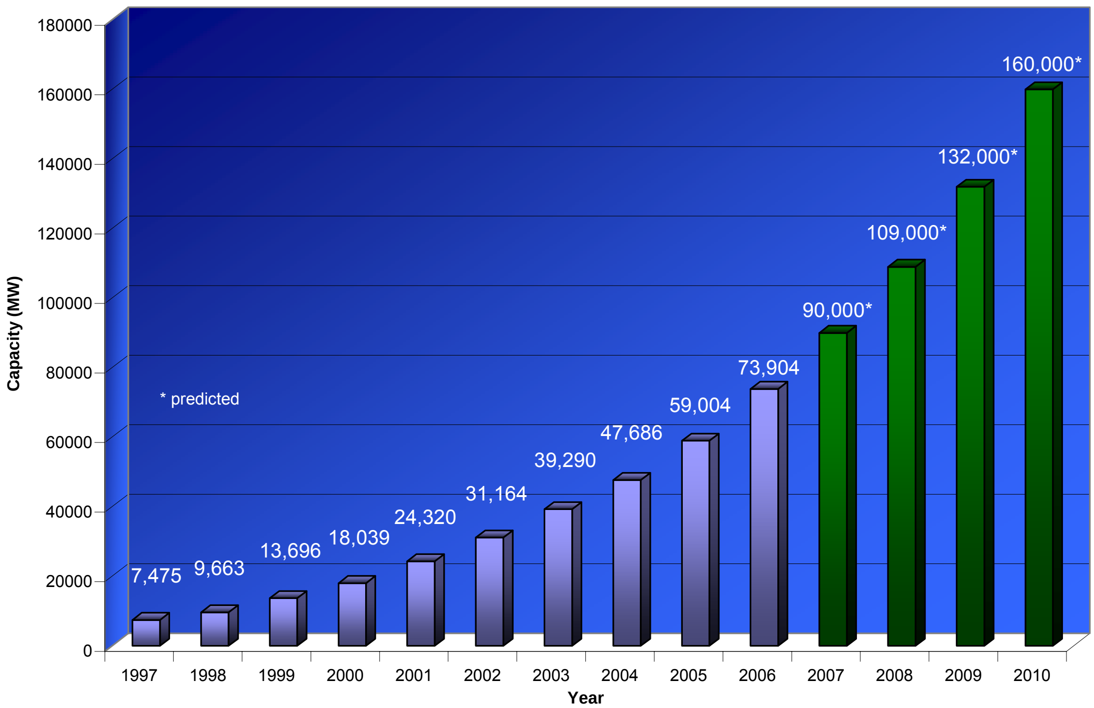
The Project was submitted in 2007 for the Manitoba Hydro 300 MW Request for Proposal (RFP). The Project was shortlisted for further consideration with nine other proposals, among 84 submissions, and subsequent to that was officially selected as the only proposal for further discussions.

The Project schedule is mostly dependent on the permitting process, the negotiations with Manitoba Hydro for the Power Purchase Agreement (PPA), weather, and equipment supply. Currently, the anticipated schedule for the three Project phases is as follows:

- Construction: from early 2009 to end of 2010;
- Operation: anticipated in-service date in early 2011; lifespan 20-25 years;
- Decommissioning: after lifespan, if PPA is not renewed and/or no upgrade possible.

1.4.2 Global and Canadian Wind Energy Contexts

The Project is part of the world's fastest growing energy sector. Globally, installed wind capacity reached 73,904 MW at the end of 2006 (WWEA, 2007), the product of approximately over 92,000 wind turbines installed in over 60 countries. According to the World Wind Energy Association (WWEA), growth in 2006 stood at 25%, after 24% in 2005. Based on current and projected rates of installation, global capacity is expected to reach 160,000 MW by 2010. Today, wind energy delivers worldwide around 1% of the global electricity generation, with some countries and regions reaching 20% and more.



(Source: WWEA, 2007)

Figure 1-1: World Wind Energy – Total Installed Capacity and Prediction (1997-2010)

Germany, Spain and the United States are currently the three leading "wind energy" nations of the world, with installed capacities (as of 31 December 2006) of 20,622 MW, 11,615 MW and 11,603 MW, respectively. India as of the same date was operating 6,270 MW, Denmark, 3,136 MW, and Canada, 1,451 MW. In 2007, Canada has seen its installed capacity grow to 1,770 MW, a figure expected to increase rapidly in the next decade: most provinces, led by Manitoba and Quebec, have launched requests for proposals (RFPs) and adopted policies to increase wind energy capacity. Ontario has targeted 4,600 MW by 2020, Quebec has 4,500 MW targeted by 2016 and both Alberta and British Columbia each expect to have a few thousand MW in place by 2020. Combined, these targets will amount to a minimum of 12,000 MW of wind energy by 2016 (CanWEA, 2008).

Wind energy's popularity is attributed to two main factors, namely technological advancements and growing interest in clean renewable power. Indeed, wind energy production costs have decreased rapidly in recent years, enabling the sector to compete, under certain conditions, with conventional power sources. Growing concerns for climate change and air pollution, along with associated initiatives such as the Kyoto Protocol and clean air standards, have compelled governments to promote wind energy as a viable and ecological solution. Many countries now have ambitious wind energy objectives to address these concerns.

1.4.3 Manitoba Wind Energy Context

Manitoba Hydro has been assessing the feasibility of wind power since the early 1990s. In 2006, the operation of Manitoba's first wind energy project, the St. Leon 99-MW wind farm, located approximately 120 km southwest of Winnipeg, was commissioned. BowArk raised funds through Air Source, the entity that financed the construction of the St. Leon Wind Farm which was ultimately acquired by Algonquin Power Income Fund.

In February 2007, Manitoba Hydro announced that wind monitoring data collected by Manitoba Hydro over the past four years were available. Manitoba Hydro issued a Request for Proposals ("RFP") a month later for the purchase of up to 300 MW of wind generated electricity. In response to the RFP, Manitoba Hydro received 84 submissions totalling over 10,000 MW. In December 2007, based on a thorough review and evaluation of these submissions, Manitoba Hydro selected 10 proposals for further consideration, with seven separate developers being invited to provide additional, more detailed information to help determine which proposals may be selected. On March 31, 2008, Manitoba Hydro announced that discussions will be initiated with one Proponent only, namely St. Joseph Wind Farm Inc., for the St. Joseph Wind Energy Project.

1.5 Regulatory Framework

1.5.1 Federal and Provincial

The Project is subject to the *Canadian Environmental Assessment Act* and, at the provincial level, the *Manitoba Environment Act* outlining the environmental assessment and licensing process for those developments that may have potential for significant environmental effects. The Classes of Development Regulation under the *Manitoba Environment Act* establishes Classes of Development which are subject to review and licensing. Wind energy projects of 99 MW are considered to be Class 2 developments and 100 MW and greater are Class 3.The first step of the Provincial process is to file a Proposal in accordance with Manitoba Regulation 163/88 – Licensing Procedures Regulation.

The Proposal should include, among other information:

- A description of the proposed Project and its location;
- Land use designation;
- A description of the potential impacts of the Project on the environment, including, but not necessarily limited to:
  - Type, quantity and concentration of pollutants to be released into the air, water or on land;
  - Impact on wildlife;
  - Impact on fisheries;
  - Impact on surface water and groundwater;
  - Forestry related impacts;
  - Impact on heritage resources;
  - Socio-economic implications resulting from the environmental impacts.

A description of the proposed environmental management practices to be employed to prevent or mitigate adverse impacts identified should also be part of the Proposal.

Table 1-1 presents the federal and provincial agencies which were given the opportunity to comment on the Project, as well as associated environmental approvals required, when applicable. It should be noted that the Project will be registered under the federal ecoENERGY for Renewable Power (ERP) program and will thus trigger the Canadian Environmental Assessment Act; Natural Resources Canada will act as the responsible authority (RA) at the federal level. Additional information on regulatory agency consultation is available in Section 4 of this report.

Table 1-1: Government Agency Involvement

Agency Involved	Approval Required	Status (Comment)
Federal		
Canadian Environmental Assessment Agency	Decision on the Environmental Screening Report (as per *Canadian Environmental Assessment Act*)	Requirements addressed in this EIS (Coordinator of the federal EA process)
Natural Resources Canada		Requirements addressed in this EIS (Responsible Authority (RA), due to request for federal funding - ecoENERGY Program)
Environment Canada		Requirements addressed in this EIS (Consulted agency) – Federal Authority (FA)
Health Canada		Requirements addressed in this EIS (Consulted agency) – Federal Authority (FA)
Indian Affairs		Requirements addressed in this EIS (Consulted agency) – Federal Authority (FA)
Transport Canada	Clearance for Aeronautical Obstruction	Application to be filed – Federal Authority (FA)
	Approval under the *Regulation for lighting of wind energy project (CARS 621.19.12)*	Application to be filed – Federal Authority (FA)
	Navigable Waters	Addressed in this EIS
NAV CANADA	Aviation Safety Approval	To be obtained
Department of Fisheries and Oceans (DFO)	Approval under the *Fisheries Act 35 (2)*	Addressed in this EIS
Natural Resources Canada	ecoENERGY Program – Approval for funding	Application filed in April 2008. (Files 5911-S23-1 and 5911-S23-2)
Environment Canada	Carcass Searches Scientific Permit required for the collection of a migratory bird; Carcass Searches Permit for salvage of migratory bird species as endangered or threatened	To be filed when required
Provincial		
Manitoba Conservation	Licence under *The Environment Act (C.C.S.M. c. E125)* and associated regulations including: • Licensing Procedures Regulation 163/88 • Classes of Development Regulation 164/88 • Joint Environmental Assessment Regulation 126/91 • Environment Act Fees Regulation 168/96 • Onsite Wastewater Management Systems Regulation, MR 8312003 • Litter Regulation 92/88 R • Waste Disposal Ground Regulation, MR 150191 Compliance with *The Endangered Species Act (C.C.S.M. c. E111)* and associated regulations.	Requirements addressed in this EIS

Agency Involved	Approval Required	Status (Comment)
	Compliance with *The Sustainable Development Act (C.C.S.M. c. S270)*	
Manitoba Conservation	Approvals, licences and permits under *The Dangerous Goods Handling and Transportation Act (C.C.S.M. c. D12)* and associated regulations including: • Dangerous Goods Handling and Transportation Regulation (MR55/2003) • Environmental Accident Reporting Regulation (MR439/87) • Storage and Handling of Petroleum Products and Allied Products Regulation (MR188/2001) • Generator Registration and Carrier Licensing Regulation (MR175/87)	Requirements addressed in this EIS
Manitoba Health	Compliance with *The Public Health Act (C.C.S.M. c. P210)* and associated regulations including: • Collection and Disposal of Wastes Regulation (MR321/88 R) • Protection of Water Sources Regulation (MR326/88 R)	Requirements addressed in this EIS
Manitoba Labour and Immigration	Compliance with *The Workplace Safety and Health Act (C.C.S.M. c. W210)* and associated regulations.	Requirements addressed in this EIS
Manitoba Infrastructure and Transportation	• Permit under The Highway Traffic Act (C.C.S.M. c. H60) and associated regulations.	Requirements addressed in this EIS
Manitoba Culture, Heritage and Tourism	Approval under *The Heritage Resources Act (C.C.S.M. c. H39.1)* and associated regulations.	To be obtained
Manitoba Water Stewardship	Compliance with: • *The Water Rights Act (C.C.S.M. c. W80)* • *The Water Protection Act (Bill 22)* • *The Water Resources Conservation and Protection Act, C.C.S.M. chapter W72*	Requirements addressed in this EIS
Manitoba Hydro	Power Purchase Agreement (PPA) requirements	Will be addressed with agreement
Municipal		
RM of Montcalm	Application for conditional use to be submitted according to Zoning By-law; Planning and Building permits	To be completed
RM of Rhineland	Application for conditional use to be submitted according to Zoning By-law; Planning and Building permits	

1.6 Report Structure

This Environmental Impact Study Report (EISR) is being submitted to the Manitoba Conservation and the Canadian Environmental Assessment Agency with the objective of fulfilling all requirements with respect to applicable provincial and federal environmental assessment certifications. As required, a Project Description Document was sent to governmental agencies, both federal and provincial, in May 2006 (Helimax, 2006).

In accordance with the environmental assessment processes at both the provincial and federal levels, this EISR is structured as follows:

- Section 2: Detailed description of the Project location, optimization process, equipment activities and schedule;
- Section 3: Detailed characterization of the biophysical and socio-economic environment;
- Section 4: Description of the regulatory agencies, public and First Nation consultation activities and programs;
- Section 5: Presentation of the assessment of effects on the biophysical and socio-economic components presented in Section 3, as well as cumulative effects and an Accidents and Malfunctions Plan;
- Section 6: Effects of the environment on the Project;
- Section 7: Summary of mitigation, impact management and monitoring commitments of St. Joseph Wind Farm;
- Section 8: Environmental assessment summary: overview of environmental advantages and disadvantages.

2 TECHNICAL PROJECT DESCRIPTION

2.1 Project Location

The Project is located in the vicinity of the town of St. Joseph approximately 85 km south of Winnipeg, and overlaps the Rural Municipalities (RM) of Rhineland and Montcalm. The turbines are distributed over an area of approximately 215 km^2 of agricultural land.

The selection of the Project location was mainly based on the local wind resource, but also on its proximity to existing transmission lines, land use, local support and constraints.

Since 2005, a meteorological tower located near the centre of the Study Area has been collecting wind data at three heights (30, 40 and 50 m) as well as temperature data. Based on the data collected, the Project is considered to have an excellent wind resource. A second tower, measuring at 40, 50 and 60 m, was installed in July 2006 near the northeastern boundary of the site to confirm previous data and provide a more accurate wind assessment. More details on the wind resource are provided in Section 3.

A 230-kV transmission line runs parallel to Highway 75. A Manitoba Hydro Station, Letellier TS, is located at the eastern edge of the site, on Road 201.

Transmission Line from Highway 75

Residence and Farm Buildings near St. Joseph

Parent Seed Farm Ltd., St. Joseph

Secondary Road near St. Joseph

2.2 Optimization Process and Project Layout

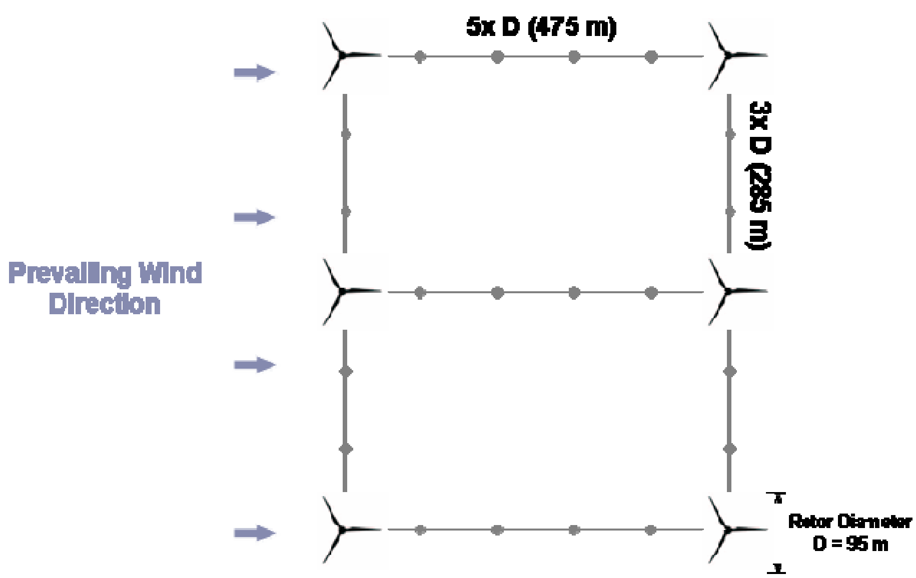
2.2.1 Project Layout

For the purpose of the environmental assessment, a maximum footprint scenario has been considered. Hence, the layout presented in Map 2-1 include 200 WTG locations, which is the highest number of turbines to be expected for the Project, assuming 1.5-MW turbines are selected. In the event that the Project is built with higher capacity turbines, the number of WTGs necessary to achieve the maximum capacity of 300 MW – and the Project footprint – will be reduced.

2.2.2 Constraints Analysis

The proposed Project has been configured to maximize its energy yield while taking into consideration a set of biophysical and human-related constraints to ensure the Project is developed in a sustainable manner. These constraints stem from regulations, existing land uses, landowner and public consultations, and expert analysis of the site's sensitivity. Field surveys were conducted by the biophysical and archaeological/traditional land use teams to identify and reference any site or area that should be avoided. Overall, few environmental constraints were identified.

Map 2-2 show the Project constraints. Table 2-1 provides a list of all constraints that were taken into account during the micro-siting of the turbines, as well as all other on-site components of the Project (i.e. access roads, transmission lines and substations). Of the 21,529 ha within the Project Area, various exclusion and buffer zones totalled 12,391 ha, leaving only 9,138 ha, or 42% of the Project Area, suitable for the installation of turbines. Within this space, turbines were sited on lands for which St. Joseph Wind Farm has signed, or will sign, a right-of-way agreement with local landowners. It is expected that more than 250 landowners will be involved in the Project. Turbines were spaced adequately so as to reduce wake effects (turbulent and slowed down wind downstream of a turbine) and associated productivity losses. Thus, the placement of individual turbines took into account a minimum of 3 to 4 rotor diameters between turbines perpendicular to the prevailing wind direction and 5 to 6 rotor diameters parallel to the prevailing wind direction (Figure 2-1). WTGs were also positioned in order to minimize noise issues for the community.



Source: Helimax

Figure 2-1: Example of Minimum Spacing between Wind Turbines to Limit Wake Effects

Table 2-1: Constraints Considered in Development of Project Layout

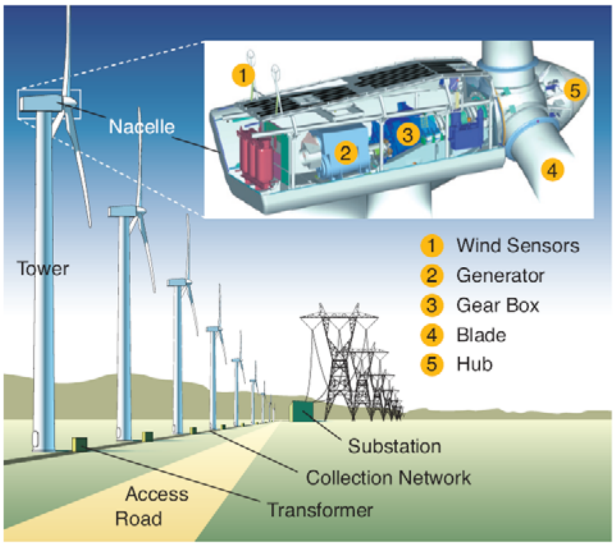
Component	Setback / Constraint	Rationale	Data Source
Biophysical Constraints			
Watercourses, Waterbodies, Marshes, Swamps	60 m	Best practice to reduce impact	Basemap data and field survey
Natural or Protected Areas	None identified		Field survey
Raptor Nests	None identified		Field survey
Bat Hibernaculea	None identified		Field survey
Human-related Constraints			
Dwellings	500 m	Most stringent local by-law[1]	Basemap data and field validation
Other Buildings	57 (blade length + 10 m) to 200 m	Best practice to reduce impact (Includes garages, accessory buildings and farm buildings)	
Property Lines	57 m, where applicable	Most stringent local by-law	Data from RMs of Montcalm and Rhineland
Roads	Main roads: 250 m Secondary roads: 150 m Accessways and trails: 57 m	Best practice to reduce impact	Basemap data and field validation
Transmission Lines and Substation	150 m	Best practice to reduce impact	Basemap data
Pipelines	80 m		Basemap data
Archaeological and Cultural Heritage Sites	300 m (depending on specific site considered)		Heritage Resource Desktop Study by professional Archaeologist
Utility Lines	150 m		Basemap data
Railway	200 m		Basemap data
Built-up Area	500 m	Most stringent local by-law	Basemap data
Point-to-Point Link Pathway and Buffer (communication)	From 93 to 477m, depending on nature of link.	RABC/CanWEA guidelines (see Section 5.15)	Industry Canada database
Technical Constraints			
Wake Effect	3-rotor and 5-rotor diameter spacing (minimal distance)	Best design practice to reduce wake effect	Engineering specifications
Noise	Mostly below 40 dBA. Some receptors between 40 to 45 dBA for participating landowners.	As per Manitoba Conservation's requirements (B. Blunt, pers. comm., 2008)[2] (See Section 5.14)	Noise simulation with 300 MW layout (WindFarmer and CadnaA models)
Slopes >15% (for turbine positions)	None	N/A	Basemap data and field validation

[1] Rural Municipalities of Montcalm and Rhineland By-Laws for Wind Energy Projects, No 653/07 and No 2005-15 respectively.

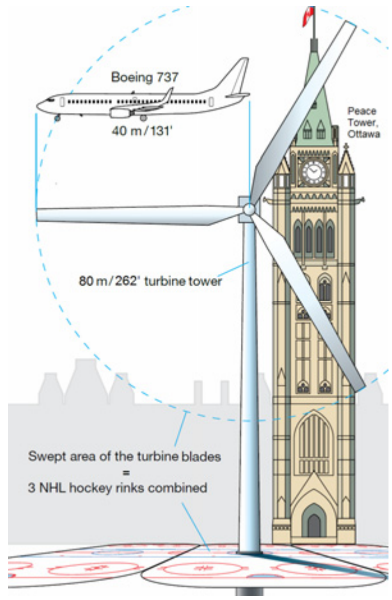
[2] Requirements to comply with CanWEA's Guidelines: *Wind Turbines and Sound: Review and Best Practice Guidelines* (CanWEA, 2007).

2.3 Project Components

The Project components and infrastructure are listed in Table 2-2 and described in detail in the following sub-sections. Figure 2-2 presents a schematic view of typical wind farm components and typical wind turbine dimensions.



Schematic View of Wind Farm Components



Typical Wind Turbine Dimensions
(modified from CanWEA)

Figure 2-2: Example of Wind Farm Components

2.3.1 Wind Turbine Generators

The wind turbine generators proposed for the Project are mainly composed of the following primary components and systems, as illustrated in Figure 2-4:

- Tower;
- Rotor (blades, rotor head, pitch control equipment);
- Nacelle (power train, braking system);
- Yaw system;
- Controller and terminal for communication (Figure 2-3). Each turbine will be mounted on a concrete foundation;
- Transformer (located within the nacelle or at the base of the tower).

Table 2-3 provides detailed specifications of the proposed wind turbines. The WTG specifications presented here were taken from the manufacturers' technical documentation.

2.3.1.1 Tower

The tower is the tapered mono-pole steel structure supporting the wind turbine generator. For a wind turbine hub height of 80 m, the tower is divided into three or four sections. The base section has a diameter of 4 to 5 m and the top section has a diameter of 3 m. The sections of the tower are connected using bolts. Tower accessories include the ladder, base for control panel, lights, safety ropes, etc.

2.3.1.2 Rotor

The rotor is composed of three blades, the rotor head (hub) and the pitch control mechanism. Each of the three blades is joined at the rotor head connected to the nacelle. The pitch control mechanism turns the blade's angle to optimize energy output. This is controlled using individual pitch control corresponding to the rotor azimuth angle and stress signal measured at the blade root. The rotor transmits the power to the power train through the mainshaft. The blade bearing is lubricated with grease.

Table 2-2: Project Components and Infrastructure

Components	Characteristics
Wind Turbines	
Maximum number	200
Model	GE 1.5 sle – 1.5MW, Mitsubishi MWT95 – 2.4 MW, or equivalent
Maximum nameplate capacity	300 MW
Collector System, Substation and Transmission (TX) Line	
Collector System (will mostly follow roads – mix of underground and overhead lines)	34.5 kV
Substations	North and south end of the Project 34.5 kV to 230 kV
TX Line from substations to Manitoba Hydro station	230 kV
Manitoba Hydro Station	Located near Letellier, on Road 201
Access Roads and Crane Pads	
New roads	59 km
Existing roads used (some of which will be improved and/or widened)	133 km
Crane pad	300 m^2 each
Other	
Met towers	St. Joseph 1 (BE22401): installed on 13 July 2005 St. Joseph 2 (BE22402): installed on 4 August 2006
Operation and maintenance building	Located with north substation
Gravel pit	Location to be determined

Blades

Blades are made from glass fibre reinforced plastic. Each blade is between 37 m and 46.2 m in length. This type of blade has maximum lift for power generation but with low drag characteristics, which minimizes the propagated noise during operation.

For lightning strike protection, multiple metal receptors are installed along the body of each blade. These receptors are connected to a down conductor wire. This will conduct the surge of lightning current from the blade to the rotor head. Blades are installed on the rotor head using T-bolts connections.

Rotor Head (Hub)

The rotor head is the component on which the three blades are connected. The rotor head is made from cast iron. The pitch control mechanisms and hydraulic cylinders of the blades are attached to the rotor head. The static, dynamic and centrifugal force in the rotor head is transmitted to the nacelle bed-plate using the main shaft bearing.

Pitch Control Mechanism

Pitch control is used to control the power generated and to prevent the wind turbine from over-speeding. The pitch control mechanism controls the blade pitch individually with individual components such as hydraulic cylinders, control valves, accumulator, and feedback sensors. In case of a hydraulic pump problem or leakage, there is an individual accumulator for each blade pitch control mechanism. During emergency situations, the accumulated pressure is sufficient enough to change the individual blade pitch into feathering position and stop or decrease the rotor rotation speed. Also changing the blade pitch individually is a more effective way of aerodynamic brake. This is because in case that a single blade will not fully change into feather position, the remaining blades will be sufficient enough to decrease the rotor rotation.

2.3.1.3 Nacelle

The nacelle includes the electrical and mechanical components enabling the production of electricity.

Power Train

The rotor is connected to the main shaft and rotates at 9-20 rpm and drives a speed increasing gearbox for wind turbine generator. The main shaft and gearbox are securely connected by a shrink disk. The gearbox is connected to the generator by a flexible type shaft coupling. The high speed shaft has a steel mounted disk brake. This brake can be engaged during routine maintenance and emergency conditions.

The gearbox transmits torque and increases the rotational speed coming from the main shaft to the generator. To reduce mechanical noise propagation, the gearbox is mounted on the nacelle using anti-vibration bushings and torque arms.

Braking System

There are two types of brakes. The first one is the aerodynamic brake which changes the pitch position of the blades. The second one is the high speed shaft brakes which use a brake disk mounted on the shaft and brake calipers. Activation of each brake depends on the many different conditions. Generally, the pitch brake is used during normal braking conditions while the high speed shaft brake is used during emergency and maintenance. Also, the high speed shaft brake is used as parking brake.

Transformer

A transformer will step up the power generated to 34.5 kV. The transformer will be located either inside the nacelle, or beside the base of the tower.

2.3.1.4 Yaw System

The yaw system is composed of a yaw bearing, gears, and brake calipers. Yawing is automatically controlled to face the dominant wind direction. The yaw bearing is lubricated with grease.

2.3.1.5 Control and Safety System

The Control and Safety System controls the blade pitch and yawing of the wind turbine during normal operating condition. The Control and Safety System protects the wind turbine using blade pitch, yaw, service brake, and generator contactors.

2.3.1.6 Foundation

Each wind turbine will require a concrete- and steel-reinforced foundation. The general assumption is that turbine foundations will require approximately 500 m^3 of reinforced concrete. It should be noted however that turbine foundation structures are being investigated by engineers, which may reduce the amount of concrete required. No blasting is expected during excavation.

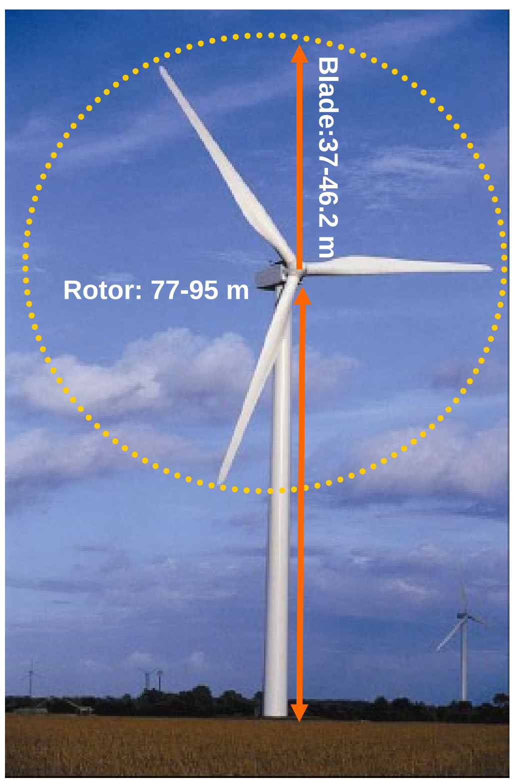


Figure 2-3: Dimensions of Major Components of the Proposed Wind Turbine Models

2.3.1.7 Crane Pad and Cleared Area

A 15 x 20 m crane pad (300 m^2) will need to be maintained adjacent to all turbines to support a crane for rotor installation, rotor maintenance (if necessary) and rotor disassembly. The crane pad will be an extension of the access roads, and be constructed with the same material.

Each turbine will also require a cleared and relatively compacted area for rotor assembly, as well as assembly of the turbine components and installation. At the most, a 100-m diameter area (0.8 ha) will be needed to facilitate assembly of the three blades with the hub and turbine erection.

2.3.1.8 Lighting

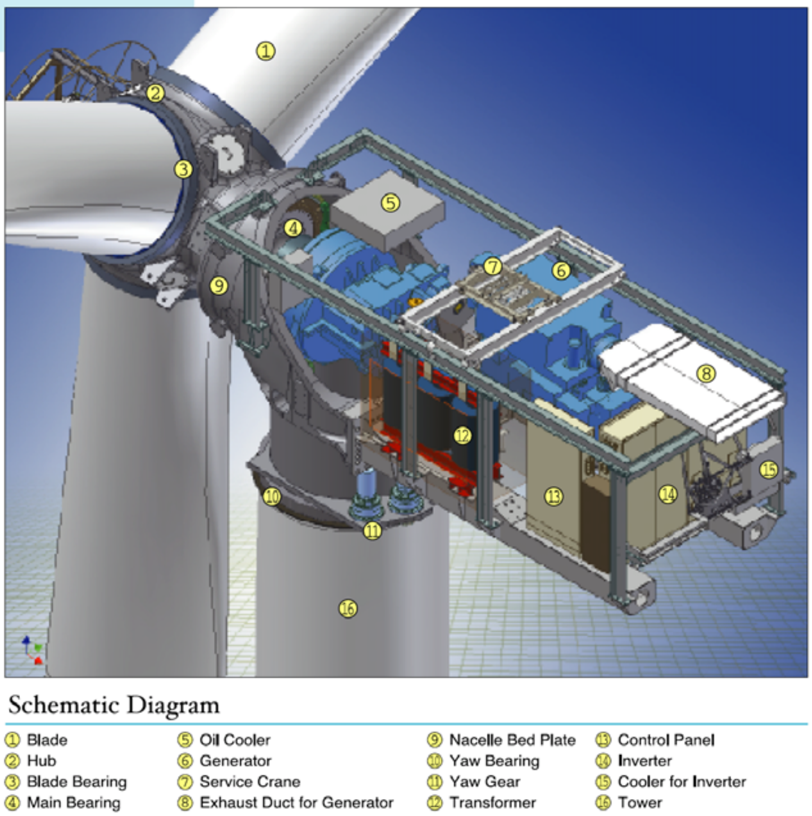
The Project will need to comply with Transport Canada's Civil Aviation Regulation 621.19 (Section 12: Marking and Lighting of Wind Turbines and Wind Parks) with respect to lighting. The general requirements for a wind farm are as follows:

- Red flashing CL-864 or white flashing CL-865 lights shall be installed to identify the area of the wind park.
- Lights will be on towers spaced out by at least 3 km.
- The dominant wind turbine, which is of a height greater than other wind turbines of the farm, shall also be lighted, if it is not included among the turbines lighted in accordance with Article 1.
- All lighting provided for a wind park shall flash simultaneously.
- Because of the variation in configuration of wind parks, the provision of lighting shall also be subject to a technical assessment in writing taking into account such factors as the general profile of the group and the type of lighting to be applied.

At time of this report, St. Joseph Wind Farm had yet to receive directions from Transport Canada regarding the number and type of the tower lighting that will be used. Based on the general guidelines, it is anticipated that approximately 20 to 30 lights may be required for the Project.

Table 2-3: Specifications for Wind Turbines

Specifications		(Maximum) Total for Project
Capacity	Between 1.5 and 2.4 MW	200
Hub Height	80 m	N/A
Tower	Steel, tubular shape, white; 3-4 sections; total length of 80 m; 4-5 m diameter at base, 3 m at nacelle; total weight approx. 110 tonnes	200
Blades	Hollow structure mostly made of fibreglass, white; length of 37-46.2 m, approx. 7 tonnes each	600
Rotor Diameter	Diameter: 77 - 95 m; Swept Area: 4,656 - 7,088 m^2	N/A
Rotation Speed	9.0 – 20 rpm	N/A
Cut-in/Cut-out Speeds	3.0 m/s – 25.0 m/s (10.8 km/h – 90 km/h)	N/A
Noise Level	103.7 - 107.3 dBA at 6 m/s wind speed	N/A
Nacelle	Houses the major components. Approximately 55 tonnes.	200
Generator	Voltage: 575 to 690 V Frequency: 50 Hz / 60 Hz	N/A
Transformer	Located in the nacelle or at the base of the tower. Steps up the WTG power generated to 34.5 kV	N/A
Estimated Total Weight of Turbine	Approximately 200 tonnes	N/A
Foundation Dimensions	Gravity-type: footprint of 400 m^2 (approx. 20 m diam. x 1.5 m deep; depending on soil conditions) Concrete Pile and Cap: footprint of 60 m^2 (8.5 m diam. x 1.5 m deep cap with 24 x 0.6 m diam. x 13.5 m deep pile)	8 ha
Estimated Excavation Size for Foundation	500 m^3 , approximately (Depending on soil condition)	N/A
Estimated Material Volume Once Excavated (per foundation)	700 m^3 , approximately (Depending on type of material excavated)	140,000 m^3
Crane pad (same material as new access roads)	300 m^2	6 ha
Temporary Footprint for Turbine Installation Area (i.e., cleared area required to assemble the turbine)	100-m diameter (0.8 ha) maximum (Conservative assumption)	160 ha
Permanent Footprint of Turbine (once assembled – includes foundation, crane pad, transformer)	700 m^2	14 ha



Source: Mitsubishi

Figure 2-4: Example of Nacelle Components

2.3.2 Access Roads

2.3.2.1 Access Roads

The Project access road network consists of new roads to be built and existing roads to be upgraded to become suitable for equipment and material delivery on the construction sites. The proposed road layout is presented in Map 2-1. Specifications for access roads are summarized in Table 2-4. The Project Area can be accessed from Highways 75, and 14, 201, and 421. Existing ditch dimensions will be maintained. New ditches along new roads will be designed and constructed within municipal and provincial requirements.

Table 2-4: Specifications for Access Roads

Specifications		Total
Straight Segments	Rolling surface	5 m
	Shoulder	3 m on each side
	Total right-of-way	11 m
Curves	Width	8 m
	Min. distance between curves	45 m
	Min. internal radius of curvature	45 m

2.3.3 Electrical Collection System, Substations and Transmission Line

2.3.3.1 Electrical Collection System

Each wind turbine will connect to a local 34.5-kV distribution system through a transformer that will step up the voltage from 575-690 V to 34.5 kV. The collector system will consist of a mix of underground and overhead cables. The electrical network will generally run parallel to the access road right-of-way (RoW) and will join at the substations planned.

The underground cabling will run within a trench 0.5 to 1.5 m wide by 1.5 m deep. The overhead collection system will be installed on 18 m wood monopoles, augered in place.

2.3.3.2 Substation

The Project will require the construction of two electrical substations. The substations will be built on a hard flat surface and will include a set of transformers, isolators, breakers, lightning conductor, support structures, high-voltage bars and control equipment. The highest structures of the substations will not exceed 8 m and it will be enclosed by a fence. The substations will increase the voltage from 34.5 kV to 230 kV.

2.3.3.3 Transmission Line

From the substations, the Project will connect to Manitoba Hydro's transmission network via two 230-kV transmission lines that will be built to join the existing station located near Letellier. The transmission lines will require a right-of-way running at the edge of the access road right-of-way. The transmission lines are expected to be on 24 m wood H-frame structures for straight runs, with 24 m laminated monopoles with guy wires for turning/tangent structures. The final 230-kV design will be the responsibility of Manitoba Hydro.

Table 2-5: Specifications for Electrical Network

Specifications	Total Length	RoW
Collection System	63.3 km 102.8 km	Overhead within road right-of-way Underground: within road right-of-way
Transmission Line	15.5 km	Additional 25 m, along existing roads

Figure 2-5: Example of Substation

2.3.3.4 Operation and Maintenance Building

A building will be built for use by employees and as a storage facility for maintenance materials and products, tools, various equipment and vehicles. It is expected that the maintenance building will be located at the north substation location.

2.3.3.5 Temporary Concrete Batch Plant

The need for a temporary concrete batch plant for the Project will be assessed during the pre-construction phase.

2.3.3.6 Water Supply

A water supply to the site is required for cleaning of trucks and staff use, as well as for concrete production if produced locally. The main water supply source is yet to be determined, but will be in one of the surrounding towns. All runoff from the site, including water from wash down pads, will be directed to sedimentation ponds. Recycled water that can be reused for some purposes will be drawn from the ponds. All water leaving the site must meet quality standards typically including total suspended solids and pH, as directed by the operational permit.

2.3.3.7 Gravel Pits

The Project requires gravel aggregate for several purposes including road construction, concrete supply and the construction of working pads and other facilities. Material could be obtained from existing local sources, or new sources may be developed.

2.3.4 Total Project Footprint

The total footprint of the Project during construction and operation is summarized in Table 2-6.

Table 2-6: Summary of Total Project Footprint

Component		During Construction [ha]	During Operation [ha]
Turbines	0.8 ha/turbine for construction 0.07 ha/turbine during operation	160	14
New Roads	59 km, 11 m width for construction 5 m width during operation	65.4	29.7
Existing Roads to be Enlarged	133 km, 6 m extra width	79.6	79.6
Electrical Collection System	166 km	Included in road RoW or turbine footprint	Included in road RoW or turbine footprint
Transmission Lines	15.5 km, 40 m RoW	62	62
Maintenance Building and Substations	North: 100 m x 50 m; South: 50 m x 50 m	0.75	0.75
Project Area	21,529 ha		
Total Footprint		368 ha	186 ha
	% of Project Area	1.7%	0.9%

2.4 Project Activities

The Project activities include the following three phases: (1) construction, (2) operation and (3) decommissioning. Each of these phases and their activities are detailed below.

2.4.1 Construction Phase

Commencement of the construction phase will be dependent on a PPA from Manitoba Hydro or other development opportunity. In any scenario, construction is expected to be completed in less than two years and will lead to commissioning.

All project components or activities will be built or undertaken according to current guidelines provided by governmental agencies, Manitoba Hydro and the turbine manufacturer (see Table 2-7 and Table 2-8). These will include Manitoba Hydro Environmental Protection Guidelines, Manitoba Transportation standards for road building, Manitoba Hydro electrical standards, and the turbine manufacturer's assumed standards with respect to transportation of turbine parts, turbine assembly and concrete foundations and those guidelines agreed to and outlined in the Manitoba Hydro Power Purchase Agreement for Wind Generated Energy.

Figure 2-6 to Figure 2-8 illustrate some of the construction activities.

Table 2-7: Project Activities during Construction Phase

Activity	Description
1. Tree Cutting, Grubbing and Clearing	Involves the cutting of trees, grubbing (removal of stumps) and clearing of all vegetation on site, if required. This activity will be restricted to only a few areas and involve minimal effort, as all turbine sites are located on cultivated land.
	If required, tree cutting, grubbing and clearing will be conducted around the turbine locations and crane pads, along new access roads, the local electrical network and the transmission line rights-of-way, substation locations, and for certain road upgrades.
2. Topsoil Stripping	Involves the removal of topsoil
	Required for surfaces covered by roads, turbine foundations, and substations
	Not required for the rotor assembly
3. Construction of New Access Roads, Crane Pads and Upgrade of Existing Roads	Planning of roadway surfacing and road limits, stabilizing of backfill, excavated material and stripped soil
	When possible, new road construction and upgrades will use existing material on site, such as excavated material from turbine sites. Gravel pits will supply additional gravel as needed.
4. Preparation of Concrete Foundations (Figure 2-6)	Excavation of material at turbine sitings, drilling of piles, preparation of cavity and installation of steel rods, and pouring of concrete foundations. Concrete foundations will cure for 2-3 weeks.
	Excavated soil/rock will be spread onto the crane pad and adjacent access roads.
	Topsoil and subsoil will be salvaged for reclamation.
5. Installation of Turbines (Figure 2-7 and Figure 2-8)	Installation consists of lifting and fixing the tower sections, lifting and fixing the nacelle to the last tower section, assembling the rotor on the ground and lifting and fixing the rotor to the nacelle. For the Project, it is assumed 8 mobile track cranes for rotor building, base/mid, and main erection. These cranes will range from 200- to 600-tonne cranes. There will also be 6-10 hydraulic RT cranes for foundations, unloading, and erection support. These rubber tire cranes will range from 60- to 130-tonne.
6. Installation of Electrical Network	Overhead cables will be attached to single wooden poles, augered in place. It is assumed that overhead cabling will generally follow access roads.
	Underground cabling will be placed in conduits underneath the concrete tower foundations. It is assumed that the underground cables will only be used in the immediate vicinity of each turbine tower to connect the turbine with the overhead network.
7. Construction of Substations	Activities include excavation, pouring of a concrete foundation, and installation of equipment and a fence. The transformers (oil-filled) are self-contained, thus pose little risk of spills.
8. Transportation and Traffic (see also Table 2-8)	This activity includes all transportation related to the Project, such as that of Project components, heavy machinery, and concrete.
	WTG component transportation will be undertaken with convoys specially permitted for oversized and overweight loads. It is assumed that convoys will travel on Highway 75 and access the site via Highways 14, 201 and 421.
	Cranes will also be transported with specialized convoys.
	Concrete trucks of 8 m^3 capacity will be used to haul the concrete to turbine sites.
	Transportation crews will be trained and equipped to respond to accidental spills. All Project vehicles will carry an emergency spill response kit.
9. Site Reclamation	Disturbed areas will be restored (e.g. revegetated or reseeded with appropriate seed mix; recontoured to compliment pre-construction drainage patterns, etc.).
	Salvaged subsoil will be replaced and capped with topsoil and salvaged organic material, including woody debris.
	Sediment and erosion controls will be implemented as required in areas of erosion risk.
	Soil tillage practices and overturning on compacted soil will be implemented.

Table 2-8: Transportation Requirements for Turbine Components if Constructed with 200 Turbines

Component	Number of Trucks Required per WTG	Total Number of Trucks	Total Number of Convoys (6 trucks per convoy)	Traffic Density Indicator (trucks/working day)	Estimated Working Days for Completion
Turbine Blades (3)	3	600	100	6	100
Towers (4 sections maximum)	4	800	200	9	134
Nacelles (1)	1	200			
Hubs and Nose Cones	1	200			
Concrete (8 m^3 hauls)	62	12,500	-	160	79

Source: Mitsubishi

Source: EBC

Figure 2-6: Foundation

Source: EBC

Figure 2-7: Tower Lift

Source: Mitsubishi

Figure 2-8: Rotor Lift

2.4.2 Operation

For the purpose of this assessment, it is assumed that the Project will be in operation for a minimum of 20 years. The exact period of operation will be specified in a power purchase agreement (PPA) to be negotiated with Manitoba Hydro. The Project could be available for an extended PPA of up to 40 years, provided that some mechanical upgrades and replacements are undertaken after approximately 20 years.

The wind energy Project's operation phase is not typically resource intensive. The regular activities pertain to computer-controlled operation of turbines and maintenance (Table 2-9).

Table 2-9: Project Activities during Operation Phase

Activity	Description
1. Operation of Turbines	The Project will have a full-time operation staff and will be controlled by use of a semi-automated computerized system, the SCADA system, and a fibre optic communication system linking each wind turbine generator installation and each substation, enabling the staff to continuously monitor 24 hours per day. The SCADA System can be accessed remotely and allows for remote reset of minor fault conditions, access to data for fault analysis and the operational adjustment of each turbine. With additional software it is possible to control the output from the site to meet the needs of the Utility with respect to planned curtailment or total shutdown if necessary.
2. Maintenance	Wind energy generation projects require little maintenance relative to fossil-fuelled facilities. Assuming approximately 10 staff per 100 MW, the Project will require 30 full-time trained wind technicians, working in teams of two (2) for safety reasons. Wind turbines are typically maintained twice a year to reduce mechanical or electrical problems. Scheduled maintenance will be carried out, where practicable, during times of low wind.
	The half-year service generally takes 1 to 2 days and consists of greasing, hydraulic filter changes where applicable, visual inspection and some diagnostic testing, including a rotor over speed test. The annual service generally takes 2 to 4 days and consists of all the 6-month items, plus full system tests, 10% bolt torquing, and gear oil filter changes. Usually, every third year the gear oil and hydraulic oil, where applicable, are flushed and renewed to maintain optimum lubrication.
	Maintenance crews will be trained and equipped to respond to accidental spills. All Project vehicles will carry an emergency spill response kit.
3. Transportation and Traffic	Regular maintenance services or site check-ups will only require minimal use of trucks, ATVs or snowmobiles. Access roads are permanent but will not be ploughed, unless an unplanned event or malfunction requires the immediate intervention of heavy machinery or trucks (use of crane, blade replacement, etc.).
	Transportation crews will be trained and equipped to respond to accidental spills. All Project vehicles will carry an emergency spill response kit.
4. Brush Clearing	Manual brush clearing will be undertaken approximately every ten years on road rights-of-way, and along the transmission line rights-of-way. No brush clearing will be required around turbine sites. Brush will be piled for burning during the early spring, when risk of forest fires is low.

2.4.3 Decommissioning Phase

As outlined in the Manitoba Hydro Power Purchase Agreement for Wind Generated Energy, the decommissioning of the Project will require the partial or full dismantling of the wind energy project components (Table 2-10). Typically, turbines and a portion of the concrete foundations, overhead electrical network and substations are dismantled.

Table 2-10: Project Activities during Decommissioning Phase

Activity	Description
1. Dismantling of Project Components	According to Manitoba Hydro's Power Purchase Agreement, it is a requirement that project components be dismantled and disposed of properly. These requirements include: complete dismantlement and removal of the turbines, collector system (overhead and underground), electrical substation, access roads, and all other installations as well as levelling of the concrete foundation down to a minimum depth of thirty-six inches below grade to enable filling with subsoil and topsoil.
	Components will be sold on the market (steel towers, electrical and substation components, blades), recycled (blades) or disposed of in designated landfill sites. Oils and greases from the gearbox, other nacelle components and the substation transformers will be flushed and sent to designated treatment facilities.
2. Transportation and Traffic	Includes all transportation associated with dismantling, including Project components, heavy machinery, and broken up concrete. Some haulage of reclamation materials may also be required.
3. Site Reclamation	Disturbed areas will be restored (e.g. revegetated or reseeded with appropriate seed mix; recontoured to compliment pre-decommissioning drainage patterns, etc.).
	Salvaged subsoil will be replaced and capped with topsoil and salvaged organic material, including woody debris.
	Sediment and erosion controls will be implemented as required in areas of erosion risk.
	Soil tillage practices and overturning on compacted soil will be implemented.

2.4.4 Schedule

If successful in obtaining a PPA, it is expected that the Project will be built to its full or partial capacity in 2009 and 2010 to ensure commissioning by 2011 (Table 2-11). Any residual capacity not acquired or bid to Manitoba Hydro may be bid into future RFPs, or the developers may explore other development opportunities. The opportunity to develop the Project is based on receiving a power purchase agreement from Manitoba Hydro or other buyer. For the purposes of this EA, it was assumed that all 300-MW would be built in 2009 and 2011.

Table 2-11: Proposed Development and Construction Schedule for Project

Project Activities	2008				2009				2010				2011			
	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
Development																
Wind resource assessment (on-going since 2005)	●	●	●	●												
Preliminary wind farm layout	●	●														
Permitting and regulatory approval		●	●	●												
Geotechnical and foundation design			●	●												
Detailed design (buildings, roads, collection system, controls)			●	●												
Site Preparation																
Site prospecting					●											
Site clearing and topsoil stripping					●	●										
Construction and Testing																
Roads and crane pads						●	●	●	●	●	●	●				
Foundation						●	●	●	●	●	●	●				
Installation of turbines							●	●	●	●	●	●				
Electrical network, substations, and maintenance building									●	●	●	●				
Manitoba Hydro interconnection design and construction									●	●	●	●				
Testing											●	●				
Site Reclamation										●	●	●				
Commissioning													●			

2.5 Project Alternatives

The 300-MW St. Joseph Project, as proposed in this Report, is considered to be a preferred wind energy project in Manitoba due to the tested wind conditions on site and the clean and renewable energy characteristics of the Project. While maximizing energy yield from the Project is an important planning factor, considerable effort has been made to modify the Project design to minimize environmental and social effects, including relocation of some turbine locations to avoid environmentally and socially sensitive areas. While alternative layouts of wind turbines could be considered, all alternatives are expected to generate equal or more adverse impacts on the environment.

3 ENVIRONMENTAL AND SOCIAL SETTING

Baseline conditions were assessed through desktop studies and extensive fieldwork on the Study Area (Map 3-1). For the purposes of this report, the term “Study Area” generally refers to the Project Area plus a buffer of 1 to 1.6 km. Fieldwork was conducted for the main valued ecosystem components (VEC) on which the Project may have potential effects. Workplans were established based on standard practice, guidelines and consultation with regulatory provincial and federal agencies. Table 3-1 lists the various components and fieldwork conducted.

Table 3-1: Valued Environmental Components and Baseline Condition Assessment

VEC	Baseline Assessment
Biophysical Components[3]	
Air and Climate	Desktop study and two meteorological towers collecting data on-site
Terrain, Geology, Soils, and Drainage	Desktop study Preliminary geotechnical investigation from February 14-19, 2007
Hydrogeology	
Aquatic Ecosystems	Collection and review of background information Site investigation: July 24-26, 2007; April 21-22, 2008
Vegetation	Collection and review of background information Site investigation: July 23-26, 2007; April 8, 21-22, 2008
Avian Fauna	Collection and review of background information Site investigation: • Spring migration: April 23 to May 25, 2007, April 7-22, 2008; at 6 stations; 15 days • Fall migration: September 9 to October 24, 2007, at 4 stations; 10 days • Raptors: June 3-22, 2007 at 2 stations; 6 days • Breeding birds: June 3, 4, 6, 7, 19, 20, 22, and 23, 2007 at 40 point count stations • Lek surveys: May 11, 12, 13, 24, and 25, 2007
Bats	Collection and review of background information Site investigation: 33 nights of monitoring in May, July, August, and September, 2007
Mammals	Collection and review of background information Site investigation: Incidental observations during other surveys
Reptiles and Amphibians	Collection and review of background information Site investigation: April 23, May 13, and June 4, 2007, at 4 stations
Human Components	
Economics and Community Setting	Desktop study
Public Services and Infrastructure	Desktop study Consultation with governmental agencies (radiocommunication inventory)
Land Use	Desktop study Consultation with landowners
Archaeology and Heritage Resources	Desktop study
Acoustic Environment	Desktop study and on-site validation of receptors: November 27-30, 2007
Landscape	Site investigation: November 27-30, 2007; May 1, 2008

[3] As a result of comments received from Environment Canada, all incidental butterfly observations were recorded during the monitoring period. Results are presented in the complete Environmental Characterization Report (Appendix A).

3.1 Air and Climate

The Study Area is located within the Lake Manitoba Plains Ecoregion 162, and is characterized by short, warm summers and long, cold winters with continuous snow cover.

Records taken between 1971 and 2000 at the nearest station to the Study Area, Altona Airport, were tabulated by Environment Canada and are summarized in Table 3-2.

Table 3-2: Meteorological Conditions from Altona Airport Station, Manitoba

Meteorological Parameter	Value
Daily average annual temperature	3.5°C
Daily July average temperature	20.0°C
Daily January average temperature	-16.6°C
Average annual rainfall	414.5 mm
Average annual snowfall	126.0 cm
Total annual precipitation	540.5 mm

Source: Environment Canada (2004)

3.1.1 Wind Characteristics

In Manitoba, winds are relatively strong, especially in spring and fall. The strongest mean winds are generally from the northwest. There are seasonal particularities in air flow directions: in summer, winds are frequent from south-southeast-east, in spring they are generally from the northeast or north, and in fall from the west.

Two meteorological towers have been collecting wind data since July 2005 and August 2006, respectively. Data recorded over 18 months indicate prevailing winds from the NNW and SSW.

The wind rose in Figure 3-1 below shows the percentage of the total recording time the wind speed has a given value in a given direction. The wind is considered “calm” if the wind speed is below 1 m/s (or 3.6 km/h). This wind rose represents observations from one tower located in the Study Area from January 2006 to December 2007. In the NNW sector, for example, the wind rose indicates that 3% of the time wind speeds are between 1 and 6 m/s, 6% of the time between 6 and 11 m/s, and 3% of the time between 11 and 16 m/s for a total of approximately 12% of the overall time for that direction. Winds are calm 1.4% of the observation time.

The simulated wind speed at 80 m height varies from 7.6 to 8.2 m/s (27.4 to 29.5 km/h) for the Study Area.

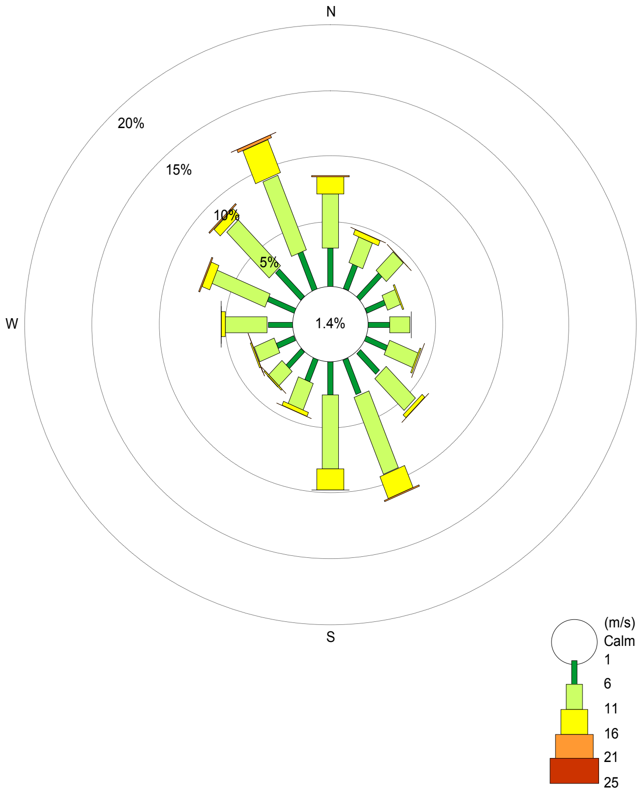
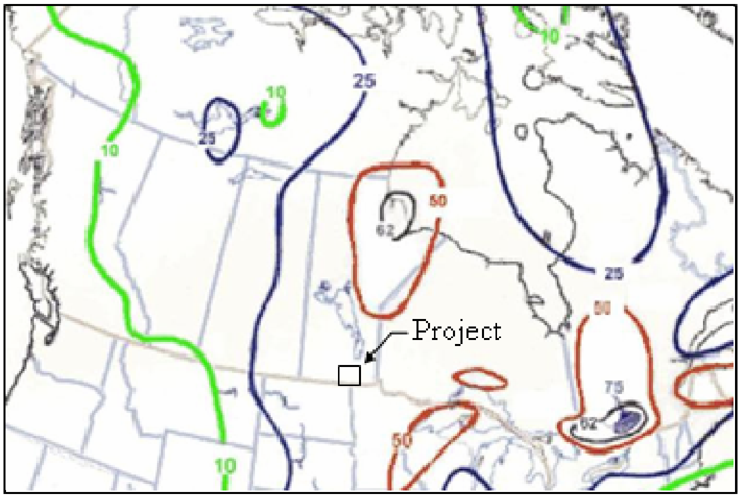


Figure 3-1: Wind Rose for St. Joseph 1 Tower

3.1.2 Freezing Rain

Freezing rain occurs on exposed surfaces with air temperatures slightly above freezing and strong winds. Local evaporational cooling may result in freezing (Glossary of Meteorology, 2000). Southern Manitoba is well known for recent icing events (Manitoba Hydro 2004). According to Environment Canada (2001), the Project is located in an area that could receive accumulation of 10 mm of radial ice on high structures and 25 to 50 hours per year of freezing precipitation (Figure 3-2).

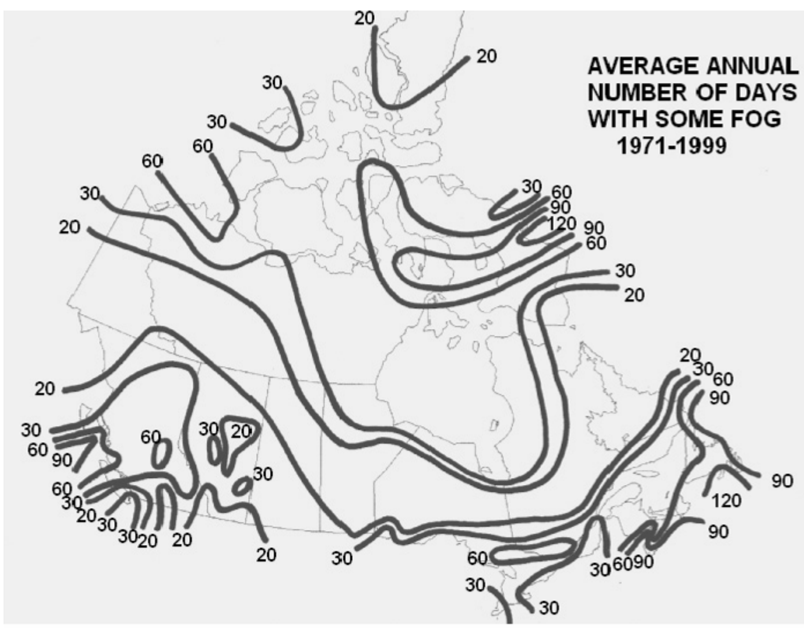


Source: Environment Canada, 2005

Figure 3-2: Average Number of Hours per Year with Freezing Precipitation (as per 1965-1988 data)

3.1.3 Fog

Fog is defined as a suspension of very small water droplets reducing the horizontal visibility to less than 1 km. Occurrence of fog is quite localized and influenced by factors such as topography, proximity to waterbodies, and soil type. According to Environment Canada (2001), Southern Manitoba is located in an area which experiences approximately 20 days of fog (visibility of less than 1 km) per year (Figure 3-3).



Source: Environment Canada, 2001

Figure 3-3: Annual Number of Days per Year with Occurrence of Fog Reducing Visibility to Less than 1 km (According to 1971-1999 data)

3.1.4 Air Quality

Manitoba generally enjoys excellent air quality which is comparable or superior to that in other Canadian provinces. Air quality concerns in Manitoba tend to be more local in nature. Sources of air pollution include industrial operations, vehicle emissions and man-made materials that are released into the atmosphere (Weather Network, 2008). The principal air emissions of concern according to the Government of Manitoba include greenhouse gases, sulphur dioxide, particulates and metals (2006).

3.2 Terrain, Geology, Soils, and Drainage

3.2.1 Terrain, Soils and Drainage

Physiographically, the Study Area lies entirely within the Red River Valley Section of the Manitoba Plain (Canada-Manitoba Soil Survey, 1980). This portion of the plain is very flat with slopes of less than 2%.

Elevation of the land surface decreases over a very gradual regional slope from 240 m above sea level (m asl) in the west, to about 222 m asl where the Red River flows north from the Project. These low surface gradients (rates of 1 m/km from west to east and 0.2 m/km from south to north) result in very slow surface drainage. The natural drainage throughout the Study Area is not well developed, as surface waters drain very slowly in a northeasterly direction via the Rivière aux Marais and the Plum River. Surface drainage for agricultural purposes is facilitated by a network of man-made drains constructed to enhance runoff and reduce the duration of surface ponding.

The soil materials consist primarily of clayey to loamy lacustrine sediments underlain in local areas by lacustrine silts deposited during the time of glacial Lake Agassiz. The combination of flat topography and high clay content makes the drainage of these soils relatively slow. The majority of soils are classified as imperfectly drained, with a poorly drained area on the northwest side of the Study Area.

Soils in the Rural Municipality (RM) of Rhineland portion of the Project have been mapped at a detailed level (1:20 000 scale) and published in Podolsky (1991). Soils in the Rural Municipality of Montcalm have been mapped at a reconnaissance level (1:126 720 scale) and published in the soil survey report for the Winnipeg and Morris map sheet areas (Ehrlich et al., 1953). Detailed soil studies at a 1:20 000 scale are available for the area around the towns of Emerson, Letellier and St. Jean (Podolsky, 1984). According to the Canadian System of Soil Classification (Expert Committee on Soil Survey, 1987), the majority of soils in the Study Area are classified as Black Chernozems, with Humic Gleysols in the northwest.

There is no significant relief and no bedrock or stoniness conditions to contend with in this area although soils associated with the floodplain of the Red River are subject to periodic flooding during spring runoff.

Most of the soils in the Study Area are rated Class 2 for agricultural capability, with local areas being Class 3. The major problem limiting the agricultural use of soils is inadequate drainage. Unfavourable workability and potential degradation due to erosion by wind are other important limitations.

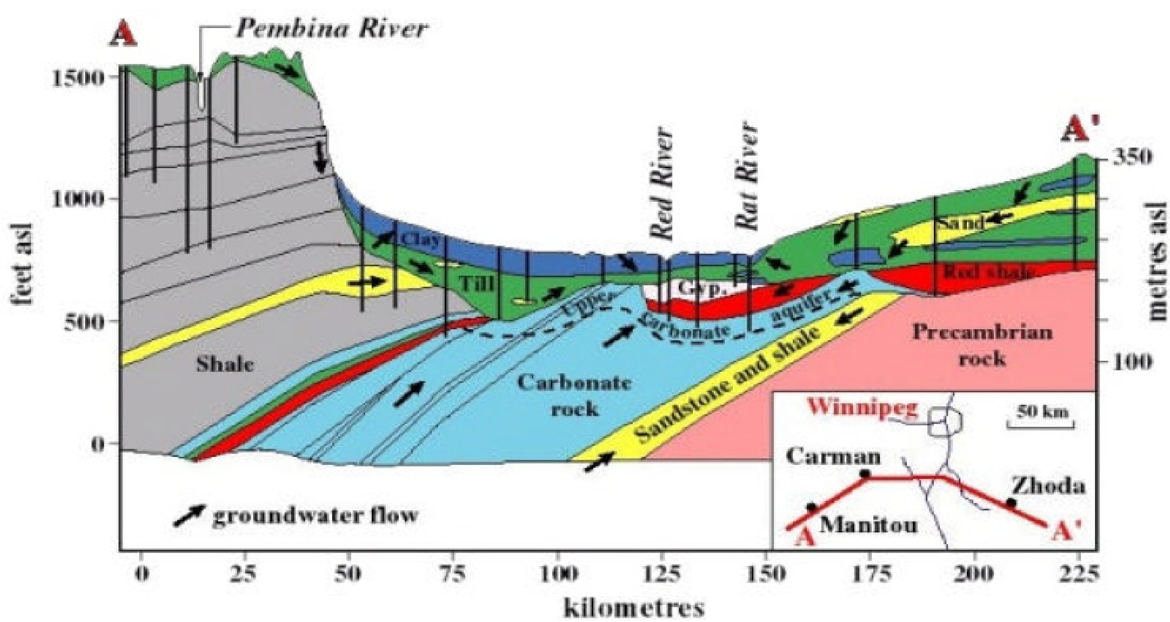
The majority of the Study Area is at Minimal to Low risk of degradation in terms of potential environmental impact (EI) under irrigation, due mainly to the heavy texture of the soil and the slow drainage. These conditions reduce the risk of deep leaching of potential contaminants on the soil surface.

Table 3-3: Soil Characteristics in the Study Area

	Rhineland	Montcalm
Slope Class	0-2%	0-2%
Surface Texture	Clayey (loamy)	Clayey to loamy lacustrine (black chernozems, a few gleysols areas in NW portion)
Drainage Class	Imperfect (poor; well)	Imperfect (poor in NW portion)
Agricultural Capabilities	Class 2 (3)	Class 2 (3 in NW portion)
Irrigation Suitability	Poor to fair	Poor to fair
Potential Environmental Impact under irrigation	Minimal (to low)	Minimal
Water Erosion Risk	Negligible (to low)	Low to moderate (negligible in NW portion)
Land Use	Annual Crop Land	Annual Crop Land

3.2.2 Geology

In April 2008, a reconnaissance geotechnical study was conducted with 3 boreholes drilled over the Project Area at depths of 34.6 m to 38.1 m. The results showed that the soil stratigraphy consists of a thin layer of topsoil and organic clay underlain by plastic clay which is encountered for 34 m to 38 m. This clay lies on a glacial clay or silt till and sand and bedrock were not encountered at any boreholes. According to the Water Resources Division of the Department of Mines, Resources and Environmental Management of Manitoba (1974), it is estimated that the bedrock lies at a depth varying between 50 m to 70 m from the ground level (AMEC 2007). Bedrock in the Red River Valley area is generally composed of carbonate rock such as limestone. Figure 3-4 illustrates the regional geology of the Red River Valley.



Source: Bell, 2007

Figure 3-4: Regional Geology of Red River Valley

3.2.3 Seismic Site Conditions

Seismic classifications and requirements are set out in the 2005 National Building Code (NBC) (Table 3-4). Based on the preliminary geotechnical investigation, the Study Area lies in a zone classified as Class D and E. Some locations might be classified as Class F, depending on further investigation.

Table 3-4: Site Classification for Seismic Response

Site Class	Ground Profile Name	Average Properties in Top 30 m		
		Average Shear Wave Velocity, V_s (m/s)	Average Standard Penetration Resistance, N_{60}	Soil Undrained Shear Strength, s_u (kPa)
A	Hard *Rock*	$V_s > 1500$	N/A	N/A
B	*Rock*	$760 < V_s \leq 1500$	N/A	N/A
C	Very Dense *Soil* and Soft *Rock*	$360 < V_s < 760$	$N_{60} > 50$	$s_u > 100$
D	Stiff *Soil*	$180 < V_s < 360$	$15 \leq N_{60} \leq 50$	$50 < s_u \leq 100$
E	Soft *Soil*	$V_s < 180$	$N_{60} < 15$	$s_u < 50$
		Any profile with more than 3 m of soil with the following characteristics • Plasticity index: PI > 20 • Moisture content: w ≥ 40%, and • Undrained Shear Strength; $s_u < 25$ kPa		
F	Other *Soils*[1]	Site-specific evaluation required		

(1) Other *Soils* include
(a) Liquifiable *soils*, quick and highly sensitive clays, collapsible weakly cemented *soils*, and other *soils* susceptible to failure or collapse under seismic loading;
(b) Peat and / or highly organic clays greater than 3 m in thickness;
(c) Highly plastic clays (PI >75) more than 8 m thick; and
(d) Soft to medium stiff clays more than 30 m thick.

Source: AMEC 2008

3.3 Hydrogeology

Given the poorly drained soils in the Study Area, the topography and the presence of the Grand River watershed, the groundwater table is expected to be found above the bedrock level most of the year, fluctuating seasonally, and rising in the soil layer in the wetter periods of spring, summer and autumn. According to the preliminary geotechnical investigation, the groundwater level could be found at depths varying between 50 to 70 m below the ground surface (AMEC 2007). These data will be assessed prior to construction during the geotechnical investigation of each wind turbine location.

3.4 Aquatic Ecosystems

The Study Area is almost entirely composed of agricultural fields which are drained by constructed linear drains. These constructed drains make up the majority of aquatic habitat in the Study Area.

The drainage in the northern part of the Study Area flows into the Buffalo River, which in turn enters Plum Creek and ultimately the Red River. The southern part of the Study Area drains into the Rivière aux Marais, which also empties into the Red River

3.4.1 Study Methodology

The aquatic habitats in the Study Area were identified and mapped based on topographic mapping information from the National Topographic Data Base (Natural Resources Canada 2002) and were confirmed and detailed through direct observations in the field. Site visits were conducted July 24-26, 2007, and on April 21 and 22, 2008.

Fish community information was obtained from Manitoba Conservation (2007a). Significant species information was obtained from COSEWIC (Government of Canada 2007), Species at Risk listed under the *Manitoba Endangered Species Act* (Manitoba Conservation 2008), and the Manitoba Conservation Data Centre (2001).

3.4.2 Aquatic Habitat

The aquatic habitats in the Study Area are defined by the clay and silt of the Glacial Lake Agassiz Clay Plain (Matile and Keller 2004). In the last century, poor drainage prompted the construction of numerous linear surface drains to facilitate drainage for agricultural purposes. Many of these drains are situated alongside the roads. The size of these drains varies from minor roadside ditches to intermediate-size drains to large drains and rivers. The intermediate and large features are shown in Map 3-2.

The drainage from the northern portion of the Study Area flows north into the Buffalo Channel – Plum Creek system. Buffalo Channel has two separate channels that enter the Study Area from the west and converge within the Study Area to become the Plum River. The Plum River exits the Study Area to the north and continues northeast to its outlet to the Red River. Drainage in the southern portion of the Study Area flows into the Rivière aux Marais, which also outlets into the Red River.

The intermediate-size agricultural drains in the Study Area are generally situated in narrow corridors of grass and other herbaceous vegetation. There is typically a road along one side and a cultivated field on the other side. The channel widths of the intermediate-sized drains vary from approximately 2 to 7 m (at the bottom of the drain). Vegetation within the channels varies. Some drains have submerged aquatic vegetation, and many have emergent cattails, sedges and rushes in sparse to high density. The intermittent drains typically have terrestrial grasses and herbaceous species growing throughout the channel. The substrates in the channels reflect the clay soils that characterize the Study Area. On July 24 and 25, 2007, some of the drains were flowing, some had standing water, and others were completely dry. Many of the drains had flowing or standing water on April 21 and 22, 2008 after a period of rain during the morning of April 21.

Some of the intermediate-sized drains empty into the larger watercourses through culverts with 1-way valves at their outlets. In the same manner, minor drains spill into intermediate-sized drains through 1-way valve systems. This is a characteristic of the land drainage scheme that prevents water from backing up through the system and flooding the landscape during high flows. These 1-way valves also have the effect of impeding upstream fish passage.

In addition to the linear drainage features, there are isolated ponds in the Study Area that serve as fish habitat.

3.4.3 Significant Fish Species

Three significant fish species and one significant freshwater mussel species may potentially be present in the Study Area. They are described in the following text and in Table 3-5.

The Chestnut Lamprey *(Ichthyomyzon castaneus)* is known from the Lake Manitoba Plain Ecoregion (Manitoba Conservation Data Centre 2001), and is known to occur in the Red River (Manitoba Conservation 2007a). The Silver Chub *(Macrhybopsis storeriana)* is known from the Lake Manitoba Plain Ecoregion (Manitoba Conservation Data Centre 2001), and is known to occur in the Red River (Manitoba Conservation 2007a). The Bigmouth Buffalo *(Ictiobus cyprinellus)* is known from the Red River, and more specifically from Buffalo Creek, part of which is within the Study Area. The Mapleleaf *(Quadrula quadrula)* is a freshwater mussel species that is known from the Lake Manitoba Plain Ecoregion (Manitoba Conservation Data Centre 2001).

Table 3-5: Significant Aquatic Species Known in Vicinity of Study Area

Common Name	Scientific Name	Srank*	Provincial Rank**	National Rank	Suitable Habitat Available in Study Area?
Chestnut lamprey	*Ichthyomyzon castaneus*	S3S4	NE	SC***	Y
Silver chub	*Macrhybopsis storeriana*	S3	NE	SC***	Y
Bigmouth buffalo	*Ictiobus cyprinellus*	N/A	NE	SC***	Y
Mapleleaf	*Quadrula quadrula*	N/A	NE	END****	Y

*Designated by Manitoba Conservation (Manitoba Conservation Data Centre 2001)
**Designated by Manitoba Conservation and protected by the *Manitoba Species at Risk Act* (Manitoba Conservation 2008)
***Designated by COSEWIC and protected by the *Species at Risk Act* (Government of Canada 2007, Gov't of Canada 2008)
****Designated by COSEWIC but pending addition to the *Species at Risk Act* (Gov't of Canada 2007, Gov't of Canada 2008)

<u>**Legend**</u>

S-rank (sub-national rank)
3 - uncommon
4 - apparently secure

Provincial and National Rank
END - Endangered
SC - Special Concern
NE - Not Evaluated

Suitable Habitat
Y - yes

3.5 Vegetation

3.5.1 Study Area

Review of aerial photographs, consultation with agency staff, and examination of the Study Area by NRSI field biologists revealed no significant natural communities within the Study Area. Background review of natural features extended well outside of the given Project Area boundaries.

The Study Area lies almost entirely in active agricultural terrain characterized by a variety of rotational crops including canola, soy, a variety of vegetables and hay. Also present within the Study Area are occasional hedgerows and small tree stands surrounding private residents and constructed ponds. The only wooded habitat within the Study Area exists along the narrow riparian corridor that follows portions of the Rivière aux Marais. Existing vegetation within the Study Area may be seen in Map 3-3. All proposed turbines will be placed in agricultural fields.

3.5.2 Study Methodology

Collection and review of background information on biological features of the Study Area and vicinity have occurred since work commenced in March 2007, and have continued up until the completion of this report. Background collection and review included frequent reference to Manitoba Conservation sources, Species at Risk sources, liaison with knowledgeable local naturalists, and agency staff. A complete list of sources used in this study is included in the Reference section of the complete Environmental Characterization Report (Appendix A).

Vegetation within the Study Area was initially mapped by means of air photo interpretation. These initial classifications were confirmed and expanded upon during field surveys from April 2007 to April 2008, including detailed field confirmation during site visits on July 23-26, 2007 and April 8, 21, and 22, 2008. Broad-scale mapping of vegetation communities using a Land Classification System was deemed unnecessary because the Study Area consists almost entirely of agricultural lands. All hedgerows and constructed ponds were mapped and grouped into three broad classifications. These classifications were based on dominant vegetation types, and included deciduous, coniferous, mixed, or shrubby. The majority of wooded areas could be grouped into one vegetation community; however, a few very small additional vegetation communities were also mapped.

All turbines and access roads for the St. Joseph Project are proposed in agricultural fields, and therefore specific plant inventories of the natural areas were not required.

Vegetation mapping of hedgerows and natural communities can be seen in Map 3-3.

3.5.3 Results

The St. Joseph Study Area is primarily composed of active agricultural crops with scattered hedgerows and small patches of vegetation around private residents and constructed ponds. The majority of hedgerows in the Study Area are composed of deciduous tree species such as Manitoba maple (*Acer negundo*), plains cottonwood (*Populus deltoides monilifera*), red ash (*Fraxinus pennsylvanica*), white elm (*Ulmus americana*), and trembling aspen (*Populus tremuloides*). There are also a few scattered white cedar (*Thuja occidentalis*) hedgerows. Occasional individual blue spruce (*Picea pungens*) and white spruce (*Picea glauca*) also occur within the Study Area.

The wooded communities along the riparian corridor can be separated into four distinct vegetation communities, community #1 being the most extensive. These communities are described in more detail in Table 3-6.

Table 3-6: Description of Vegetation Communities

Vegetation Community	Species
Community #1	This is the largest wooded community in the Study Area and is composed of bur oak (*Quercus macrocarpa*), Manitoba maple, willows (*Salix* sp.), plains cottonwood (*Populus sargentii*), sugar maple (*Acer saccharum*), balsam poplar (*Populus balsamifera*) and linden species (*Tilia* sp.).
Community #2	This is a small cultural community adjacent to the riparian corridor consisting of scattered bur oak and spruce species in grassy pasture.
Community #3	This is a small cultural woodlot associated with a tributary of the Rivière aux Marais, consisting mainly of maples and willows.
Community #4	This community is a grassy marsh surrounded by decidous trees in a low area adjacent to Highway 75.

3.5.3.1 Natural Areas

The Project Study Area does not overlap with any designated natural areas or protected areas (Manitoba Conservation 2007b; 2007c; Firlotte 2008, pers. comm.).

3.5.3.2 Significant Plant Species

No provincially or nationally rare plant species have been recorded within the boundaries of the Study Area (Firlotte 2008, pers. comm.).

3.6 Avian Fauna

3.6.1 Study Methodology

Using the Environment Canada matrix in *Wind Turbines and Birds: A Guidance Document for Environmental Assessment* it was determined that this site should be ranked as a "High" sensitivity site and the proposed undertaking would be classified as very large facility size (Environment Canada's Canadian Wildlife Service 2007). The proposed undertaking is classified as a Category 4 Level of Concern. The site sensitivity of the St. Joseph Project was deemed "High" as a result of the following criterion:

- The site contains species of high conservation concern (i.e. birds known to have aerial flight displays).

A variety of studies were conducted to characterize the avifauna found in the Study Area and to determine whether there were any Species at Risk or significant concentrations of birds within the St. Joseph Study Area. These studies included spring and fall migration monitoring, breeding bird surveys, diurnal raptor monitoring, and lek surveys. In total, 40 bird surveys were conducted between April 23, 2007 and April 22, 2008. Detailed study methodologies and results are described in Appendix A. Monitoring stations are located in Map 3-4.

3.6.2 Results

Over the course of the monitoring period, a total of 21,006 individual birds, representing 88 different species were observed within the Study Area. Blackbird and sparrow species were the most common species observed.

Throughout the daytime bird migration monitoring in spring and fall 2007, a total of 6428 individual birds were observed representing 56 species. During spring 2008 migration monitoring, an additional 647 birds were observed representing 30 species. The majority of observations throughout the monitoring period were of individuals or small flocks of landbirds. Bird activities in spring and fall were consistent with increased movements during migration periods, although large migratory movements were not observed in the Study Area in either spring or fall. Bird species and activity observed during the spring 2007 and spring 2008 monitoring periods were very similar, with a peak in activity near the end of April.

Over the course of the breeding bird surveys, a total of 1693 birds were recorded representing 38 species. The most abundant species observed were Red-winged Blackbird (*Agelaius phoeniceus*), Brown-headed Cowbird (*Molothrus ater*), and Brewer's Blackbird (*Euphagus cyanocephalus*). The majority of species observed were landbirds. The greatest diversity of species was observed in hedgerow habitat, followed by riparian habitat. The lowest species diversity was observed in agricultural habitat. A total of 36 species displayed some evidence of breeding, with 7 species confirmed to be breeding within the Study Area.

Only 10 raptors were observed during the diurnal raptor surveys. The raptor species observed were Northern Harrier (*Circus cyaneus*), which was most abundant, Red-tailed Hawk (*Buteo jamaicensis*), and unidentified raptor species. Six additional species of raptor were recorded during 2007 and 2008 field surveys not specifically focused on raptors.

No leks or individual ground birds were observed within the Study Area.

3.6.2.1 Significant Bird Species

Species at Risk

The Study Area is located in the Lake Manitoba Plain Ecoregion of Manitoba (Manitoba Conservation 2001). Within this Ecoregion, Manitoba Conservation lists 12 species of birds as species of conservation concern, 8 of which are considered Species at Risk by COSEWIC (Government of Canada 2007) and/or Manitoba Conservation (Manitoba Conservation 2008). These species, their Sub-national ranks (S-rank) and their provincial and national Species at Risk designations are listed in Table 3-7.

One of these species has been confirmed within the St. Joseph Study Area by NRSI. One flock of 40 American White Pelicans (*Pelecanus erythrorhynchos)* was observed flying through the Study Area during the spring 2008 migration surveys. Suitable habitat for this species does not occur within the Study Area and due to their flight height (over 150 m) it is likely the flock was only passing through the area. No records collected from the Manitoba Conservation Data Centre indicate the presence of any of the 12 Conservation Priority birds within the Study Area (Firlotte 2008). Two of these species, the Least Bittern (*Ixobrychus exilis*) and Sprague's Pipit (*Anthus spragueii*), have been recorded by Environment Canada (2006b) in the general vicinity of the Study Area (within approximately 15-20 km), but have not been recorded within the Study Area. Additionally, Environment Canada has also recorded the Yellow Rail (*Coturnicops noveboracensis*) in the general vicinity of the Study Area. The Yellow Rail is considered Special Concern by COSEWIC but is not considered at this time to be provincially significant by Manitoba Conservation. Suitable habitat for the Yellow Rail, which prefers wet habitat such as marshes, wet meadows and floodplains, does not occur within the Study Area.

Suitable habitat for 7 of these species does not exist within the Study Area. It is possible that 5 of these species – the Loggerhead Shrike (*migrans* and *excubitorides* sub-species), Baird's Sparrow (*Ammodramus bairdii*), Burrowing Owl (*Athene cunicularia*), and the Red-headed Woodpecker (*Melanerpes erythrocephalus*) – may find suitable habitat within the Study Area. However, critical habitat required for both breeding and foraging for these species does not exist within the Study Area. None of these species have been recorded during more extensive field surveys undertaken by NRSI biologists.

No Species at Risk were observed by NRSI biologists within the St. Joseph Study Area. Only one species of conservation concern, American White Pelican, was observed within the Study Area. A single flock of this species was observed flying through the Study Area, at a height well above typical turbine blade heights.

Priority Landbird Species for Bird Conservation Region 11

Four birds observed by NRSI are considered priority birds in the St. Joseph Study Area: Northern Harrier, Prairie Falcon (*Falco mexicanus*), Clay-coloured Sparrow (*Spizella pallida*), and Bobolink (*Dolichonyx oryzivorus*). A complete list of priority species found in Bird Conservation Region 11, as well as their habitat preferences and reasons for their priority status can be found in Table 3-7.

3.6.2.2 Significant Bird Areas

There are no known significant bird areas in or adjacent to the Study Area (IBA 2004).

Table 3-7: Significant Avian Species Known in the Vicinity of the Study Area

Common Name	Scientific Name	S-rank*	Provincial Rank**	National Rank***	Suitable Habitat Available in Study Area?
American White Pelican	*Pelecanus erythrorhynchos*	S3B	NE	NAR	N
Baird's Sparrow	*Ammodramus bairdii*	S2S3B	END	NAR	P
Barred Owl	*Strix varia*	S3S4	NE	NE	N
Black-crowned Night-Heron	*Nycticorax nycticorax*	S3S4B	NE	NE	N
Burrowing Owl	*Athene cunicularia*	S1B	END	END	P
Caspian Tern	*Sterna caspia*	S3B	NE	NAR	N
Least Bittern	*Ixobrychus exilis*	S3B	NE	THR	N
Loggerhead Shrike	*Lanius ludovicianus migrans*	S3S4B	END	END	P
Loggerhead Shrike	*Lanius ludovicianus excubitorides*	S1B	END	THR	P
Piping Plover	*Charadrius melodus*	S2B	END	END	N
Red-headed Woodpecker	*Melanerpes erythrocephalus*	S3S4B	NE	THR	P
Sprague's Pipit	*Anthus spragueii*	S2S3B	THR	THR	N

*Designated by Manitoba Conservation (Manitoba Conservation Data Centre 2001) - S-Rank: Subnational Rank
**Designated by Manitoba Conservation and protected by the *Manitoba Species at Risk Act* (Manitoba Conservation 2008a)
***Designated by COSEWIC and protected by the *Species at Risk Act* (Government of Canada 2007; Government of Canada 2008)

<u>Legend</u>

S-rank
1- very rare
2- rare
3- uncommon
4- apparently secure
B- breeding status

Suitable Habitat
N-No
P- Potentially

Provincial and National Rank
NE- Not Evaluated
END- Endangered
THR- Threatened
NAR- Not at Risk

3.6.2.3 Bird Species with Aerial Flight Displays

Several species of birds are known to perform aerial flight displays, which may put them at risk of collision with turbine blades. During the bird monitoring period, the Bobolink (*Dolichonyx oryzivorus*), Horned Lark (*Eremophila alpestris*) and Vesper Sparrow (*Pooecetes gramineus*) were observed by NRSI.

Bobolinks perform song flights which can reach 2 to 40 m in height which is just below the height of the proposed turbine blades. These song flights are frequent during the breeding season (Martin and Gavin 1995). The song flight of the Horned Lark can be as high as 80 to 250 m in height and can last from 0.5 to 8 minutes in length. Because of the height of its flight, it runs the risk of collision with turbine blades (Beason 1995.). Lastly, Vesper Sparrows ascend to approximately 25 to 75 m before flying horizontally for 100 to 200 m. These activities put them into the sphere of the turbine range and therefore at risk of collision with turbine blades (Jones. and Cornely 2002).

3.7 Bats

3.7.1 Study Methodology

Initial analysis of background materials, including topographic and vegetation mapping, was conducted to identify any natural features that may concentrate bat activity. To date, the Province of Manitoba has not produced any recommended guidelines for monitoring bats at potential wind farm sites (Watkins 2008). Therefore, recommended protocols developed in Ontario (OMNR 2007) and Alberta (AFWD 2005) were consulted to guide bat monitoring at the Study Area. Natural features were compared with the August 2007 Draft Bat Guidance Document for wind farm monitoring in Ontario, in order to determine the sensitivity level of this project. The St. Joseph Project was determined to be a "Medium" sensitivity Project due to proposed turbines within 5 km of the Red River. Other than its proximity to the Red River, there are no features within or around the Study Area that are likely to concentrate large numbers of bats.

A total of 33 nights of bat monitoring were conducted between May 21st and September 9th, based on guidelines in Alberta (AFWD 2005) and Ontario (OMNR 2007), and on recommendation from Manitoba Conservation in previous licenses. Monitoring occurred at six monitoring stations throughout the initial Study Area, representing a variety of habitats. Agricultural, hedgerow, and riparian habitats were all represented by the six monitoring stations. In addition to through-the-night monitoring of bat activity, transect point counts were conducted throughout the Study Area to determine if concentrations of bat activity are present within the Study Area. Locations of bat monitoring stations can be seen on Map 3-5.

Acoustic monitoring was used to gather information on usage rates of bats in different areas and habitats within the Study Area. Data was collected and analyzed for the presence of bat passes, and total passes through the night. Passage rates (passes/hr) were calculated based on total number of passes recorded and length of monitoring period. Bat 'calls' were also recorded directly into laptop computers using Pettersson D240x ultrasonic monitoring devices, through SonoBat software. The calls were recorded using a time expansion of 10x, and were analyzed with SonoBat software, and compared with recorded calls of known species. Call sonograms were compared on the basis of peak frequency, call length, call shape, harmonics, and other acoustic attributes.

Detailed study methodology and results from 2007 bat monitoring at the St. Joseph Study Area can be found in Appendix A.

3.7.2 Results

A total of six species of bats occur in Manitoba. Of these, three are year-round residents that hibernate during the winter months. These species are Big Brown Bat (*Eptesicus fuscus*), Little Brown Bat (*Myotis lucifugus*) and Northern Long-eared Bat (*Myotis septentrionalis.* The remaining three species – Silver-haired Bat (*Lasionycteris noctivagans*), Red Bat (*Lasiurus borealis*), and Hoary Bat (*Lasiurus cinerus*) – migrate south in late summer and early autumn. None of these species are endangered, threatened, or vulnerable in Manitoba. The Little Brown Bat is considered a common breeder in Manitoba but a rare summer resident as very little is known about its summer ranges (Manitoba Conservation Data Centre 2001).

Terrain features such as ridges are not found within the Study Area. The shoreline of the Red River may provide attractive habitat for bat species. The nearest proposed turbine is approximately 1.1 km from the Red River. Within the Study Area, there are scattered hedgerows, isolated trees and barns that will provide some potential roosting habitat for local bat populations. Aquatic habitats are limited to agricultural drains, streams and constructed ponds within the Study Area, and are not expected to concentrate large bat populations within the Study Area.

The Alberta Fish and Wildlife Department recommend that bat monitoring be conducted in late summer and early fall in their pre-construction protocols (AFWD 2005). Similarly, the Study Area is considered a "Medium Sensitivity" site according to the Ontario government's guidelines for monitoring potential impacts to bats at wind power locations and therefore only recommends monitoring from August through mid-September (OMNR 2007). Based on the little information available on bat movements through Manitoba, NRSI decided to conduct bat monitoring during the anticipated period of spring bat migration. However, based on the recommendations and guidelines for both Alberta and Ontario, the spring bat migration monitoring effort was considerably less then the summer and fall monitoring effort.

During spring migration monitoring, a total of 16 bat passes were recorded in 18.2 hours of acoustic monitoring, resulting in an overall passage rate of 0.9 passes/hr. The highest passage rate (1.8 passes/hr) was observed at BAT-001. Passage rates varied considerably throughout the night with peaks in activity between 2030hrs and midnight and secondary peaks in activity between 0230hrs and 0530hrs. No concentrations of bats were observed during the spring monitoring period.

Summer swarming and fall migration monitoring was conducted from late July to mid-September. The passage rate peaked in August with an average of 5.3 passes/hr, while July and September averaged lower rates of 0.5 and 1.1 passes/hr, respectively. A peak passage rate of 17.5 passes/hr was observed on the night of August 18/19. Passage rates through the night peaked prior to midnight and activity remained high until 02:30hrs before slowly declining during the remainder of the morning.

Four of the six bat stations were monitored in the Study Area during the summer swarming and fall migration period (BAT-001, 004, 005, and 006). The reduction in the number of stations monitored compared to the spring monitoring period was due to changes to the proposed turbine layout and general project boundaries in mid-summer. The highest passage rate of any station was 8.7 passes/hr observed at BAT-001, which is located near a pond surrounded by deciduous trees (see Map 3-5). The other three stations were much more consistent and had much lower passage rates compared to BAT-001. BAT-004 and BAT-006 both had passage rates of 1.1 passes/hr and BAT-005 had the lowest passage rate recorded of 0.5 passes/hr. These stations were located along deciduous hedgerows and field edges.

3.7.2.1 Significant Bat Species

According to Manitoba Conservation (2008) and Species at Risk (Environment Canada, 2006), no significant bat species are known or expected to be within the Study Area.

3.8 Mammals

3.8.1 Study Methodology

A background review was conducted prior to field surveys to determine a list of species known to occur within the Study Area (Banfield 1981, Environment Canada 2006, Watkins 2005). While conducting field surveys, observations of mammals and signs were recorded including nests, burrows, scat, tracks, and dams. Mammals such as white-tailed deer, coyote, and red fox likely use the agricultural fields as movement corridors.

Significant mammal habitat is defined as winter deer yards, fawning/calving sites, denning sites, staging areas, mineral licks, bat hibernaculae, and mammal movement corridors. According to the Manitoba Conservation Data Centre (Firlotte 2008), no significant mammal habitat is present within or near the Study Area.

3.8.2 Results

A total of 39 non-bat mammal species are known from the vicinity of the Study Area based on information collected during the background review. Common species such as Coyote (*Canis latrans*), Jack Rabbit (*Lepus townsendii*), Thirteen-lined Ground Squirrel (*Spermophilus tridecimlineatus*), and White-tailed Deer (*Odocoileus virginianus*) were observed within the Study Area. Additionally, a den, likely belonging to a Red Fox (*Vulpes vulpes*), some Raccoon (*Procyon lotor*) tracks, and Pocket Gopher (*Thomomys talpoides*) mounds were observed within the Study Area.

3.8.2.1 Significant Mammal Species

Species at Risk

Three species, the Eastern Wolf (*Canis lupus lycaon*), the Grey Fox (*Urocyon cinereoargenteus*) and the Plains Bison (*Bison bison bison*) all have range maps that overlap with the Study Area (Banfield 1981) and are considered species at risk in Manitoba by COSEWIC (Government of Canada 2007).

The Eastern Wolf is considered a Special Concern species by COSEWIC and has been documented in the vicinity of the Study Area (within approximately 20 km) by Environment Canada (2006), however, the necessary forest cover that this species requires is not found within the Study Area. The Plains Bison and the Grey Fox are considered Threatened in Canada. Habitat for these two species does not occur within the Study Area. The Plains Bison requires meadow and grassland areas to graze and the Grey Fox prefers deciduous woodlands and marshes.

No records of any Species at Risk have been documented in the Study Area (Firlotte 2008). None of these species were observed by NRSI biologists within the Study Area.

Provincially Rare Species

In addition to the already mentioned species, one species, the Plains Pocket Gopher (*Geomys bursarius*), has been assigned a sub-national rank of S3 (uncommon) by the Manitoba Data Conservation Centre (Manitoba Conservation 2001). NRSI observed gopher mounds and tunnels throughout out the Study Area but it is unknown what species made them because the animals were not observed directly. The Northern Pocket Gopher is much more common and widespread in southern Manitoba.

3.9 Reptiles and Amphibians

3.9.1 Study Methodology

Potential presence of reptiles and amphibians was assessed through review of background material and literature review. On-site habitats observed during vegetation surveys were also reviewed and compared with preferred habitats of herpetofauna species known to the vicinity of the Study Area. Based on assessments of amphibian habitat, monitoring took place at four monitoring stations within the Study Area (see Map 3-6). Each station was monitored 3 times, once in early spring, once in mid-spring, and once in late spring/early summer. All incidental wildlife sightings, including reptiles and amphibians, within the Study Area were documented.

3.9.2 Results

Three species of reptiles and 8 species of amphibians are known from the vicinity of the Study Area (Preston 1984) (see Table 3-8). During the 2007 amphibian monitoring, 5 species were recorded within the Study Area. The species recorded calling most frequently was the Boreal Chorus Frog (*Pseudacris triseriata maculate*). American Toads (*Bufo americanus*), Wood Frogs (*Rana sylvatica*), Canadian Toads *(Bufo hemiophrys*) and the Northern Leopard Frog (*Rana pipiens*) were also recorded in the Study Area, much less frequently.

The Study Area is primarily agricultural, with occasional permanent creeks, and numerous intermittent drainage ditches that provide habitat for frog and toad species tolerant to these conditions. Three reptiles, including 2 snakes and 1 turtle, have range maps that overlap with the Study Area. Ideal habitat for these species, such as larger permanent bodies of water or rocky areas for basking, does not exist within the Study Area. No reptiles were observed by NRSI in the Study Area.

Table 3-8: Reptiles and Amphibians with Ranges that Overlap with Study Area

Scientific Name	Common Name	Suitable Habitat within Study Area?	G-rank	S-rank*	National Rank**
Turtles					
Chelydra serpentina serpentina	Common Snapping Turtle	Y	G5T5		
Snakes					
Opheodrys vernalis	Smooth Greensnake	N	G5	S3S4	
Thamnophis sirtalis parientalis	Red-sided Gartersnake	N	G5T?		
Salamanders					
Ambystoma tigrinum	Tiger Salamander	Y	G5		NAR
Ambystoma tigrinum diaboli	Gray Tiger Salamander	Y	?		
Toads and Frogs					
Bufo americanus	American Toad	Y	G5		
Bufo hemiophrys	Canadian Toad	Y			NAR
Hyla chrysoscelis	Cope's Gray Treefrog	Y	G5		NAR
Pseudacris maculata	Boreal Chorus Frog	Y	G5		
Rana pipiens	Northern Leopard Frog	Y	G5		SC
Rana sylvatica	Wood Frog	Y	G5		

* Designated by Manitoba Conservation (Manitoba Conservation Data Centre 2001)
**Designated by COSEWIC and protected by the *Species at Risk Act* (Government of Canada 2007; Government of Canada 2008).

Legend

Suitable Habitat
Y - Yes
N - No

G-rank (Global Rank)
G5 - Very Common

S-rank
S3 - Uncommon
S4 - Apparently Secure

COSEWIC
NAR - Not at Risk
SC - Special Concern

3.9.2.1 Significant Herpetofauna Species

Species at Risk

One species with a range map that overlaps with the Study Area, the Northern Leopard Frog, is considered a Species at Risk in Manitoba (Government of Canada 2007). However, the Northern Leopard Frog is not ranked or protected provincially (Manitoba Conservation 2008). This species was heard calling by NRSI biologists during amphibian surveys in a drainage ditch near HRP-004. Near this drainage ditch are large ponds associated with the Miller Environmental property. This observation was made more than 200 m from the nearest proposed turbine location.

3.10 Economic and Community Setting

3.10.1 Demographics

The Project straddles the Rural Municipalities (RM) of Rhineland and Montcalm, which have populations of 4125 and 1317 inhabitants, respectively. The nearest communities in the vicinity of the Project are Altona, Rosenfeld, Letellier and St. Joseph. For the purposes of the present analysis, information was taken from the 2006 Census (Statistics Canada, 2006) municipal profiles in an effort to produce as comparative a portrait as possible between the two rural municipalities and the province of Manitoba.

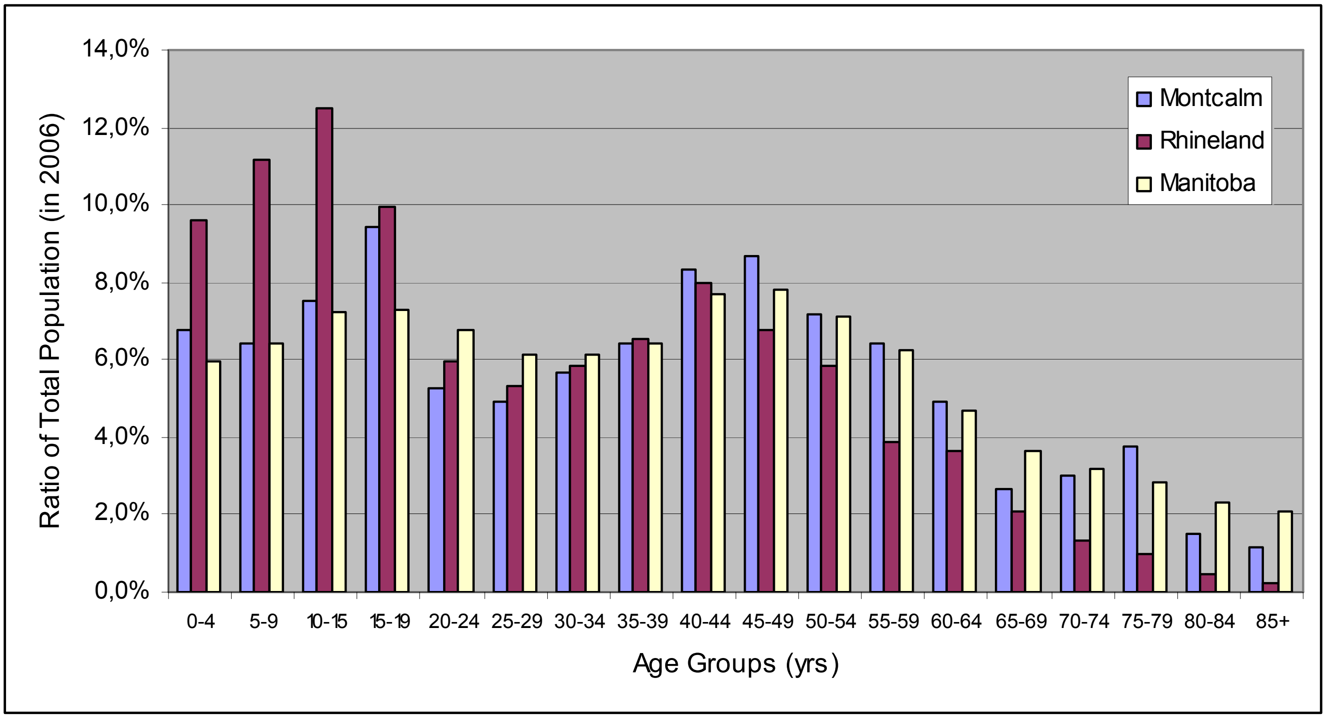
Table 3-9 presents population in 2006 and 2001, showing a population decrease for both RMs while overall population in Manitoba increased by 2.6%. The RM of Montcalm showed a decrease in population of 5.9%.

Table 3-9: Population and Dwelling Counts

	Montcalm	Rhineland	Manitoba
Population in 2006	1317	4125	1,148,401
Population in 2001	1400	4183	1,119,583
Change [%]	-5.9	-1.4	2.6
Total private dwellings	497	1,104	491,724
Private dwellings occupied by usual residents	479	1,075	448,766
Population density per square kilometre	2.8	4.3	2.1
Land area [km^2]	469.41	953.42	552,369.96

Source: Statistics Canada – 2006 Census

In terms of age distribution, both RMs, especially that of Rhineland, have a higher ratio than the province of Manitoba for the younger age groups (up to 19 years old). For the 25 to 44 year-old groups, the provincial values and the RM have relatively similar ratios. The 25-44 year-old age group has direct correlations with the work force. For the older age groups, the RMs have similar or lower ratios than the Province. It should be noted that the RM of Montcalm shows slightly higher ratios than Rhineland for the older age groups, being closer to the provincial average. Figure 3-5 shows population by age groups.



Source: Statistics Canada – 2006 Census

Figure 3-5: Comparative Age Distribution for the RMs of Montcalm and Rhineland, and the Province of Manitoba

3.10.1.1 First Nations

According to Statistics Canada (2006), a total of 145 of Montcalm's citizens and 20 of Rhineland's citizens identify themselves as Aboriginal. The nearest First Nation territory is Roseau River Reserve which has an area of 2225 ha and is located 6 km east of the Project. The Roseau River Anishinabe First Nation has 568 members living on the Reserve (Statistics Canada, 2006).

Within the Reserve population, 30% work in the service sector such as health care, social, educational, finance and business services. The remainder are involved in agricultural, construction and manufacturing industries.

3.10.2 Socio-Economic Overview

The major economic activities in the area are agriculture, farming, and tourism. The area has ideal land for growing crops such as wheat, barley, flax, oats, corn, canola, and sunflowers. The alfalfa industry is growing due to demand for the crop by dairy farmers in the United States. There are also many seed farms. A variety of specialty crops are grown, such as soup peas and beans. Some cattle and hogs are also raised in the area. There are also some dairy farms located around Letellier and St. Joseph.

Many local businessmen have set up shops to cater to the region's farmers. Throughout the community, several businesses provide supplies, and equipment ranging from seed, fertilisers and chemicals to equipment, parts and mechanical services. Small- and medium-sized manufacturing firms exist in many of the urbanized communities, and in the incorporated centres of Altona, Gretna, and Plum Coulee. Many of these firms produce agricultural products such as equipment and parts. Some, however, produce specialty goods for domestic shipment and international export (Manitoba Community Profiles, 2006).

As presented in Table 3-10, income statistics of the RM of Rhineland are similar to those of the Province. The RM of Montcalm shows a median household income higher than that of the Province of Manitoba. Employment rates of the RMs are approximately 10% higher than those of the Province.

Table 3-10: Income Population Profile and Labour Force Activity

	Rhineland	Montcalm	Manitoba
Total population 15 years and over	2740	1045	908,450
Median total income [$][4]	20 714	24 003	20 138
Median household income [$]	48 807	53 314	47 875
In the labour force	2,095	810	611,280
Employed	*2,050*	*785*	*577,710*
Unemployed	*40*	*25*	*33,570*
Not in the labour force	645	235	297,170
Participation rate	76.5	77.5	67.3
Employment rate	74.8	75.1	63.6
Unemployment rate	1.9	3.1	5.5

Source: Statistics Canada – 2006 Census

3.10.3 Economic Sector

3.10.3.1 Occupations

The top five private sector employers in the RM of Montcalm consist of three special crop exporters (Parent Seed Farm, Roy Legumex Inc., and Sabourin Seed Service Ltd., with 35, 27 and 26 employees respectively), Miller Environmental Corporation, operating a waste treatment facility with 20 employees, and BSI Insurance, with 20 employees.

In the RM of Rhineland, Loewen Manufacturing Company, providing agricultural equipment and parts, and WJ Siemens Farming Company (agricultural crops) are the two main employers with 58 and 57 employees each. Ecusta Fibres (flax straw processor), Giesbrecht Trucking (long-distance hauling), and H. Fehr Company (agricultural crops), employ 43, 40, and 30 employees, respectively (Manitoba Community Profiles, 2006).

3.10.3.2 Tourism and Recreational Activities

The Red, Roseau and Plum rivers, home to some 35 different species of fish, attract anglers and tourists. Other tourist attractions are the Old Convent that was built in 1897 in St. Jean, the St. Joseph museum, opened seasonally, where 12 historic buildings, restored tractors and agricultural machinery depict pioneer life and French Canadian heritage, and a historic cairn in Letellier commemorating the Roseau River route, used by French explorers and fur traders in the 18th century. A family festival, the Montcalm Heritage Festival, occurs every year around June in Letellier. In Altona, the world largest replica of a Van Gogh's painting figures amongst local tourist attractions, as does the campground located in Buffalo Clear Creek Park.

At the Neubergthal Mennonite Street Village, a designated National Historic Site located on Road 421 a few kilometres southeast of Altona, tourists can learn about the Mennonite communities in Manitoba and their history, as well as contemplate the well-preserved infrastructures. Guided tours of the village are offered.

A section of the TransCanada Trail, *Altona-Gretna-Rhineland Trail*, which follows the Canada-U.S. border, passes 3.3 km south of the Project Area. This trail is used for hiking, cycling, horseback riding and snowmobiling and for various regional school events (TransCanada Trail, 2008).

[4] A median income refers to the median total income of persons 15 years of age and over reported for persons with income.

3.11 Public Services and Infrastructures

3.11.1 Water supply

The Pembina Valley Water Coop Inc. supplies the local population with water pumped from the Red River and treated at the Letellier station.

3.11.2 Health Care

There are three hospitals in the area, the Altona, Emerson and Morris Hospitals. A medical clinic and a personal care home can also be found in Altona.

3.11.3 Education

There are elementary schools in St. Jean-Baptiste and Rosenfeld, a Junior High School in Altona, high schools in St. Jean-Baptiste and Altona. The nearest post-secondary schools (universities and colleges) are located in Winnipeg (Manitoba Community Profile, 2008). Letellier Elementary School closed in September 2007.

3.11.4 Police and Fire Corps

Police services are provided by the Red River Unit of the RCMP and offices are located in the towns of Altona and Emerson. The nearest fire department is located in Letellier.

3.11.5 Transportation

In terms of transportation, a railroad used by CN, CP and Burlington Northern runs north-south along the Red River. There is also an important freight and trucking traffic from and to the U.S. on Highway 75. Altona is home to a small airport which the nearest one to the Project Area.

3.11.6 Radiocommunication, Radar and Seismoacoustic Systems

In Canada, Industry Canada is responsible for attributing frequencies and managing the electromagnetic spectrum. Industry Canada's Assignment and Licensing System (ALS) database and the Technical and Administrative Frequency List (TAFL) were consulted in March 2008 to identify various types of registered radiocommunication and radar systems. The Canadian National Seismograph Network (CNSN) webpage was consulted to identify seismoacoustic systems.

The main types of telecommunication, radar and seismoacoustic systems identified in the Study Area are described in the report presented in Appendix B. These systems include the following:

- Point-to-Point Systems;
- Multipoint Distribution Systems;
- Over-the-Air Reception (Radio and TV Broadcasting);
- Satellite Systems;
- Land Mobile Radio Systems;
- Cellular Type Network;
- Aeronautical Radionavigational Aids;

- Air Defence, Vessel Traffic and Air Traffic Control Radar Systems;
- Weather Radars;
- Seismoacoustic Systems.

The report in Appendix B is consistent with the recommendations of the RABC/CanWEA Guidelines (Radio Advisory Board of Canada and Canadian Wind Energy Association, 2007), and includes an impact assessment.

3.12 Land Use

Land use of the Project and surrounding areas mainly consists of agricultural activities and some recreation activities such as hiking, horseback riding and snowmobiling. The most extensive land use after agricultural activities remains urban development.

According to the Mineral Disposition Maps of the Manitoba Science, Technology, Energy and Mines, there are no mineral mining or quarry activities in the Project Area.

The area directly affected by the Project is entirely located on privately-owned agricultural fields. Activities on site are mainly related to agricultural activities by the lot owners as the soil in the Project Area is valued agricultural land. Access to the Project Area is provided by paved and unpaved municipal roads. Photographs presented in Section 3.15 of this report illustrate typical local land use.

More than 250 landowners will be involved in the Project through right-of-way agreements with St Joseph Wind Farm Inc.

3.13 Archaeology and Heritage Resources

A desktop heritage resource impact assessment (HRIA) was conducted in August 2007 by Northern Lights Heritage Services. The HRIA evaluates the effect that a proposed development may have upon physical or cultural heritage resources that are known or thought likely to be present, and recommends ways to mitigate the loss or destruction of those resources. The HRIA is required under the *Manitoba Environment Act*, and Section 12(2) of the *Manitoba Heritage Resources Act* (1986). The Study Area considered for this assessment included the Project Area and a one-section area outside the Project Area boundary. The report (see Appendix C) presents the cultural history of southern Manitoba, describing successively the following Periods:

- Pre-contact Period:
    - Early Pre-European contact Period (11,500 – 7,000 YA);
    - Middle Pre-European contact Period (7000 – 2500 YA);
    - Late Pre-European contact (2500 B.P. to 300 YA);
- Contact Period:
    - Early Historic Period (1650 – 1821 A.D.);
    - Middle Historic Period (1821 – 1870 A.D.);
    - Late Historic Period (1870 – 1930 A.D.).

The report also describes the St. Joseph historical background and the archaeological and cultural heritage resources in the Study Area, as summarized in Sections 3.13.1 and 3.13.2 below.

3.13.1 St. Joseph Historical Background

St. Joseph was first known as Mission de la Rivière aux Marais, after the river flowing past Letellier. Archbishop Taché established a parish here in 1877 and named it St. Joseph, after the patron saint of Canada. The area was largely settled by French Canadians from Quebec (Manitoba Conservation 2000). Research indicates that the Francophone settlement originated not from historic Métis but from expatriate Québécois who had previously fled to New England (Lehr 1996).

Prior to its establishment as a settlement the area was known for its rich bison resources. A number of Aboriginal trails criss-crossed the Study Area and this network was later used by European explorers and traders. This area may have first been historically noted by La Vérendrye during his 1738 expedition to the Mandan Nation in North Dakota. The explorer, Alexander Henry, is known to have established his major post at nearby Park River in 1800, sending small detachments to winter at Rivière aux Marais (near St. Joseph) and Hair Hills (Manitoba Culture, Heritage and Citizenship 1994: 3).

The Boundary Commission Trail extended west from the Red River at the town of Emerson (Fort Dufferin) and was originally used by traders and hunters until the 1870s and 1880s when it was adopted as a route for the North West Mounted Police.

3.13.2 Archaeological and Cultural Heritage Resources in the Study Area

Southern Manitoba is rife with heritage resources dating back as far as 11,500 years ago. Part of the heritage resource desktop study is to document all known heritage resources within the Study Area. For the Project, the registered heritage sites within the boundaries of the Project Area represent the late historic period. No pre-European contact period sites have been registered within the Project Area. However, several sites that are attributed to the Archaic and Woodland periods (*ca.* 6000 to 350 years ago) are found around the periphery of the wind farm Project Area, indicating that there may be unrecorded sites present. The registered sites are listed in and located on the constraints map (Map 2-2) as per the coordinates provided by the Province of Manitoba Archaeological Inventory for archaeological sites.

The existing heritage resource inventory identified seven historical sites within the Project Area. These include four Centennial Farms, one plaque and two buildings. Sites found a distance of one land section, i.e. 1.6 km (1 mile) outside the boundary of the Project Area included four Centennial Farms, two plaques, two buildings and four archaeological sites.

Archaeological site DgLi-5, located in the southeastern corner of the Study Area, was identified as a “Kill Site”, possibly where bison were slaughtered. Projectile points identified as Besant (*ca.* 2000 – 1200 YA) were found at the said site. It was considered to be in poor condition in 1986 and may be completely destroyed due to agricultural activities.

Site DgLi-1 (Braun Site) is located along Road 201 west of St. Joseph. The site was identified in 1986 as a Late Woodland site (*ca.* 1000 – 350 YA). Site condition was noted to be almost completely destroyed. It is known that Mr. Todd Braun carried out an extensive collection of projectile points over many years in this area and there may be many sites that were never registered with the province. Consequently it is highly likely that additional sites exist within the Project Area. Further, burial mounds have been identified east, south and west of the Study Area. Therefore it is possible that burial mounds/burials could be encountered.

In addition to the pre-European contact component, the network of historical major trails and a subset of local trails exist. Additionally, there are numerous homesteads representing the first French settlers and the later Mennonite farmers who helped establish the area.

3.13.3 Neubergthal National Heritage Site

Neubergthal is located on Provincial Road 421, some 16 km west of Highway 75, southwest of the Project Area and only a few kilometres southeast of Altona. In 1999, the population was estimated at 120 persons.

In 1989, the village was recognized by the Historical Sites and Monument Board as an example of the distinctive form of group agricultural settlement known as the Mennonite Street Village. Neubergthal was then designated a Federal National Historic Site because of its “unique sense of place” and because the characteristic architecture and layout remain largely undisturbed as an excellent example of a typical Mennonite Street Village on the Canadian Prairies.

As described in the Commemorative Integrity Statement (Parks Canada and Neubergthal Heritage Foundation, 1999), Neubergthal was founded in 1876 when a group of related families settled on land which, together with some additional families, they entered as homesteads between 1876 through the 1880s. “Altogether this constituted a block of six sections of land: Sections 25, 26, 35, 36 of Township 1, in Range 1 West, West of the Principle Meridian; and Sections 1 and 2 of Township 2, in Range 1 West. The village included the actual residences and farmyards as well as communally-owned arable fields and pasture lands. The physical boundaries of the village of Neubergthal were articulated in the Village Agreement of 1891 (…). The same six sections of land essentially still define the village of Neubergthal, as there has been remarkable continuity, and as the boundaries of municipality and school districts etc. have respected the initial village boundaries.”

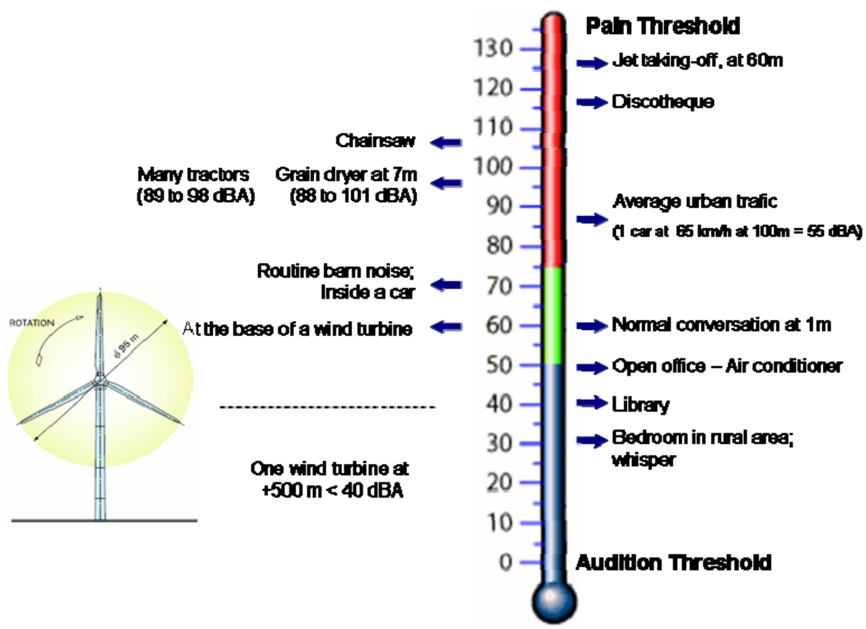
Nowadays, through the Neubergthal Heritage Foundation, guided tours of the village are offered and tourists from various parts of Canada, the U.S., and Europe come to visit each year.

3.14 Acoustic Environment

Ambient sound levels within the Project Area and on adjacent lands are typical of rural agricultural Manitoba. As such, sounds originate mostly from agricultural activities (tractors and other machinery), residential activities, vehicle traffic (mainly near Highway 75 and Provincial Roads 14, 201, and 421), and ambient noise induced by wind. As most residences are surrounded by trees, most of the ambient noise other than human-induced noise would be induced by wind in the trees. Figure 3-6 presents the sound-level scale with examples of sound sources and associated sound levels.

The Project Area is on privately-owned agricultural land and is frequented mostly by local farmers and residents. It should be emphasized that there is low human activity in the Project Area due to low population density. There are residents within the Project Area but no turbine is sited within 550 m of any dwellings. This distance exceeds setbacks that were adopted by the RM of Montcalm of 500 m for dwellings, and it complies with CanWEA guidelines (CanWEA, 2007).

Presently, there are no wind energy projects installed in the region, the only other wind warm in Manitoba being located at St. Leon, approximately 100 km to the north-west.



Sources: Canadian Hearing Society; New York Center for Agricultural Medicine and Health; Helimax

Figure 3-6: Sound-Level Scale with Typical Noise Levels in A-weighted Decibels (dBA)[5]

[5] The decibel (dB) is a unit used to measure the intensity of noise. Decibels add up on a logarithmic scale and each increase of 3 dB represents a doubling of sound energy, e.g., two sources of 60 dB at the same location would produce the same sound energy as a single source of 63 dB. Different weighting scales are used in the measurement of decibels. The scale most often used is the A scale (dBA).

3.15 Landscapes

The dominant landscape feature in the Study Area is the agricultural plain with its open views, square parcel lot structure, tree rows and man-made infrastructures (silos, barns, houses). The Study Area also presents other types of landscape: typical small town Manitoba townscapes (Letellier, St. Joseph, Altona and Rosenfeld) and Mennonite-style Street Village (Neubergthal and others).

3.15.1 Existing Viewscape

The viewscapes of the agricultural plains are characterized by openness and by the presence of man-made infrastructures. The foreground consists of hedgerows, telephone poles and trees and is intermittent. The average vertical elevation of this foreground is 8° high. The middle ground consists of continuous tree rows generally located approximately 1.5 km away. The average vertical elevation of this middle ground is 3° high.

Figure 3-7: Typical View of Agricultural Plain Landscape in Study Area

The viewscapes of the villages are more closed. The density of buildings and the proximity of tall trees (cottonwoods) compose a continuous foreground that rises up to 15° of vertical elevation for an observer located on the main street.

Figure 3-8: Typical Urban Fabric of Townscape in Study Area

3.15.2 Valued Viewpoints

Valued viewpoints have been identified in the Project Area. These viewpoints are located in the surrounding villages and along Highway 75, along the Trans Canada Trail and in the village of Neubergthal. All these viewpoints present a specific interest because of, respectively, the density of observers, the recreational purpose and the acknowledgement as a National Heritage Site. These viewpoints are key elements of the visual impact assessment (Section 5).

Figure 3-9: Typical View of Street Village of Neubergthal

Figure 3-10: Typical View from Trans Canada Trail Located South of Project

4 CONSULTATIONS

4.1 Landowners and General Public

4.1.1 Various Meetings

Several meetings and discussions took place from 2005 to 2007. Before BowArk held public meetings with the community, there was a committee known as the “St. Joseph Wind Project Review Committee” which represented the community at large and reviewed proposals from 4 different wind power development companies. BowArk had two presentations with these committee members, one on May 4, 2005 and the second in the following months. The committee was responsible for deciding with which development company the local community would sign, and it selected BowArk. Numerous communications were held with the president of the committee, Rénald Parent.

BowArk had three public meetings with the St. Joseph community on March 23, 2005, December 12, 2006, and August 23, 2007 to give updates on the Project status. Attendance to these meetings varied from 20 to 50 persons. Through letters and the St. Joseph Wind Project Review Committee, the entire community was invited to attend these meetings. The main concerns raised were:

- Economics;
- Noise;
- Visual;
- Crop spraying;
- Shadow flicker;
- Impact on agriculture.

In general, the population has been largely supportive of the Project. Opposition comes from a small group of residents living near St. Joseph.

The EA coordinator met with Mr. Rénald Parent of the St. Joseph Wind Project Review Committee on November 23, 2007. EA work status as well as principle landowner and community concerns were discussed.

4.1.2 EA Open House

An Open House was held on April 8, 2008, at the St. Joseph municipal hall, from 5:00 pm to 9:00 pm. The local population was invited through ads in the local papers (Red River Valley Echo, March 28 and April 4, 2008). It was estimated that over 150 persons attended the Open House, with 140 names registered on the sign-in sheets. Attendees came mostly from the surrounding towns of Altona, St. Joseph and Letellier, but also from Winnipeg, St. Jean-Baptiste, and other areas as indicated in Table 4-1.

Representatives from Manitoba Conservation, RMs of Montcalm and Rhineland, and Manitoba Science, Technology, Energy and Mines were also present. Journalist from The Manitoba Co-operator and the Red River Valley Echo also attended.

Five representatives of St. Joseph Wind Farm (representing Babcock & Brown and BowArk Energy), and four representatives of Helimax (EA Coordinator, wind farm specialist and noise expert, and two biologists) were present to give information about the various aspects of the Project and the environmental assessment work. More than 30 boards showing maps, visual simulations and the Project layout were on display, as well as a slideshow presenting information on the Proponent, Project schedule, and construction photos. A one-pager document explaining the Project was available to the public, as well as flyers presenting wind energy issues and information. Most information was available in both French and English. Comment sheets were also available at the entrance. These documents are included in Appendix D.

Table 4-1: Open House Attendance and Place of Origin

Place of Origin	Number of Attendees	Ratio
Altona	34	24%
St. Joseph	26	19%
Letellier	18	13%
Winnipeg	11	8%
St. Jean-Baptiste	9	6%
Rosenfeld	4	3%
St. Malo	3	2%
St. Boniface	3	2%
Morden	2	1%
Somerset	2	1%
Roseau River	2	1%
Morris	2	1%
Bordeaux	1	1%
Sommerfield	1	1%
Oak Bluff	1	1%
Winkler	1	1%
Unknown	*20*	*14%*
Total	**140**	**100%**

4.1.2.1 Issue Scoping

No unexpected issue was brought up to the EA team during the Open House. The following concerns were addressed by the specialists:

- Turner Siting:

  Siting was explained through the set of boards presenting the Project's setbacks and constraints, remaining land available for turbines, simulated noise levels and resulting layout. Most landowners had not realized typical siting constraints and noise issues and were expecting to have more turbines on their land.

- Size of the Project:

  Most attendees were expecting a smaller project.

- Noise:

  Explanations were given with respect to simulated noise levels, recommended noise levels and national guidelines, provincial requirements, etc. A sound level meter connected to a laptop computer was on display familiarize attendees with the decibel scale versus ambient noise levels. Most attendees were reassured once given the explanation, though the small group of opponents present remained unconvinced.

- Visual:

A set of 10 boards presenting visual simulations from various viewpoints across the Project Area was on display.

- Crop spraying:

  The St. Leon wind farm experience was beneficial to demonstrate the minimal impact of the wind farm on crop spraying. A landowner from the St. Leon project who has WTGs on his land attended the Open House. He was able to provide valuable information on his experience working with pilots and the Owner/Operator of the St. Leon wind farm to ensure his land was sprayed.

In the weeks following the Open House, concerns were expressed by the representatives of the Village of Neubergthal, directly to St. Joseph Wind Farm and also through Parks Canada and the CEAA, regarding the potential presence of wind turbines in the Neubergthal landscape and the visual impact on this National Historic Site.

On May 1, 2008, Ms. Krahn and Ms. Klippensten were met by the EA coordinator to address the Village's concerns. Details on the village history, national significance of the site, and the work of the Foundation were presented by the representatives. Helimax presented the Project's context, layout, visual simulations and activities, including the EA process. Sensitive viewpoints were identified, from which several photos were taken in order to produce visual simulations. Ms. Krahn and Ms. Klippensten emphasized the fact that a 3.2-km (2-mile) setback from the northern and southern extremities of the main street should be considered in order to preserve the visual landscape.

4.1.3 Additional EA Open House

Maps, noise analysis and visual simulations presented at the April 2008 Open House were based on a 125 2.4-MW WTGs layout. As previously mentioned in this report, the actual Environmental Assessment considered a "maximum impact scenario" of 200 wind turbine locations. In order to present the revised maps and visual simulations to the population, the Proponent will hold an additional Open House at the end of September 2008.

4.2 Regulatory Agency and Local Authorities Consultation

4.2.1 Federal and Provincial Authorities

In May 2006, a Project Description Document (PDD) was sent to the CEAA and to provincial agencies. Agencies responded with the following comments, issues and requirements for the environmental assessment:

- Transport Canada expressed the requirement to apply for an Obstruction Clearance for Aviation Safety.
- The Department of Fisheries and Oceans indicated that it did not have enough information to make a determination on its interest in the Project related to fish habitat. It expressed interest in further information on the locations and types of stream or waterbody crossings that might be required for the Project and the mitigation measures associated therewith.
- Indian and Northern Affairs Canada (INAC) and Industry Canada (IC) indicated that they had no interest in the Project or specialist advice to offer.
- Environment Canada commented that migratory birds and bats should be addressed in a forthcoming EIS report, as well as Species at Risk.
- The CEAA indicated that, at this stage, there was no federal trigger to undertake a screening level environmental assessment as per the *Canadian Environmental Assessment Act*.
- The Historic Resources Branch of Manitoba Culture, Heritage and Tourism recommended that the Proponent contract an archaeological consultant to conduct a survey of the proposed wind turbine

generator locations and associated access roads, in order to identify and assess any heritage resources that may be negatively impacted by construction.

- Manitoba Conservation had no comments on the PDD at the time.

The PDD was sent again to Manitoba Conservation in April 2007, prior to initiating the environmental field work, in order to schedule a scoping meeting. Since no specific guidelines exist for wind energy projects in Manitoba, it was suggested for the Proponent to check the Public Registry that contains comments from the agency on other wind energy projects. A review of other proposals and the concerns expressed with respect thereto would provide a more comprehensive understanding of what is expected by Manitoba Conservation Habitat Management & Ecosystem Monitoring Wildlife and Ecosystem Protection Branch for the environmental work. It was stated that previous proposals had been particularly deficient in detailed vegetation cover / habitat maps, which is required by the Branch to comment on necessary fieldwork (Pers. Comm., F. Phillips, Manitoba Conservation, April 2007).

Since the beginning of 2008, correspondence with Manitoba Conservation, the CEAA, and NRCan have been underway to discuss either specific issues, such as provincial noise requirements, or more general items such as Project status, the timeline for the EIS report review, and the coordination of the federal-provincial review process. Discussions with provincial and federal authorities will continue throughout the EA process.

4.2.2 Local Authorities

Several meetings and discussions have taken place between St. Joseph Wind Farm representatives and both the RM of Montcalm and the RM of Rhineland councils and staffs since the early development phase of the Project, in 2005. Topics discussed included:

- RMs involvement in the Project including total land usage in each municipality and potential number of wind generating units per municipality;
- Review of landowner compensation package;
- Overview of tax contributions per wind turbine generator;
- Local employment opportunities during construction and operation of the Project;
- Use, improvement and maintenance of existing roads and new roads.

Helimax met with Mr. Roger Vermette on November 23, 2007 to discuss the EA work status, as well as main community concerns. Helimax also attended at the Municipal Hearing on setbacks on May 2, 2008.

Both rural municipalities support the Project and discussions with local authorities will continue throughout the design, construction and operation phases of the Project.

In order to maintain a high level of involvement with the local community, St. Joseph Wind Farm has committed to donating $20,000 per year to the St. Joseph Museum. This contribution will aid in the completion of the proposed expansion plans for the museum and help facilitate a potential wind power exhibit.

4.3 First Nations

Numerous attempts to contact the Roseau River Anishinabe First Nation were made. The Project Description Document was sent on three occasions, twice to Mr. Eugene Littlejohn and once to Mr. Carl Roberts. St. Joseph Wind Farm stated that they would be pleased to address any comments, questions or concerns the Roseau River First Nation would have regarding the Project.

Although no official discussion was engaged, two residents of Roseau River were present at the EA Open House.

5 ASSESSMENT OF EFFECTS, MITIGATION AND MONITORING

5.1 Assessment Approach

5.1.1 Project-Specific Effects

The approach used for assessing the effects of the Project on the environment is based on NRCan's *Environmental Impact Statement Guidelines for Screenings of Inland Wind Farms under the* Canadian Environmental Assessment Act (2003). This assessment aims to identify and determine the significance of *residual* effects, i.e. the effects that remain after applying mitigation and compensation measures. In effect, this approach consists of the following steps:

- Determine interactions between Project activities and "Valued Ecosystem Components" (VEC)[6], i.e. identify which activities can potentially affect a specific component of the environment;
- Describe the effect and identify mitigation measures;
- Evaluate the significance of the residual effect, based on Table 5-1 below (NRCan, 2003);
- Propose follow-up and monitoring measures. Depending on the outcome of the effects assessment, follow-up and/or monitoring programs could be proposed in order to further investigate the potential effects, or verify the significance of the effect following commissioning.

Table 5-1: Levels of Residual Effects

Residual Effect	Level of Concern	Significance
Potential impact could threaten sustainability of the resource and should be considered a management concern. Research, monitoring and/or recovery initiatives should be considered.	High	Significant
Potential impact could result in a decline in resource to lower-than-baseline but stable levels in the Study Area after project closure and into the foreseeable future. Regional management actions such as research, monitoring and/or recovery initiatives may be required.	Medium	Significant
Potential impact may result in a slight decline in resource in study area during the life of the Project. Research, monitoring and/or recovery initiatives would not normally be required.	Low	Not Significant
Potential impact may result in a slight decline in resource in study area during construction phase, but the resource should return to baseline levels.	Minimal	Not Significant

5.1.2 Cumulative Effects Assessment

A cumulative effects assessment (CEA) was prepared according to federal guidelines. The CEA will include the following steps:

- List and describe current and foreseen projects in the vicinity of the Project;
- Evaluate the significance of the cumulative effect stemming from the addition of the Project to the other current and foreseen projects. This assessment will use the level of residual effects table provided above.

[6] For the purposes of this assessment, VECs will broadly refer to any environmental but also social component, such as landscapes, or land use.

5.2 Air and Climate

5.2.1 Introduction and Scoping

Construction and decommissioning activities can affect air quality by producing dust and fugitive emissions (i.e., tailpipe exhaust emitting CO_2 and nitrous and sulphur oxides) mainly due to heavy machinery use and transportation. As vehicle use during operation will be infrequent and of low intensity, tailpipe exhaust during this phase will be minimal and are not considered further in the assessment.

The potential for the following types of construction- and decommissioning-related emissions were assessed:

- Dust emissions;
- Criteria Air Contaminant (CAC) emissions;
- Greenhouse Gas (GHG) emissions.

5.2.2 Effects Assessment

5.2.2.1 Dust Emissions

Construction-related activities, including stripping of topsoil, road construction and upgrading, installation of infrastructures and electrical lines, as well as restoration of the Project Area, might create or stir up dust and temporarily increase particulate matter concentrations. Transportation of the Project equipment, as well as traffic generated by workers might also create dust, particularly on the unpaved municipal roads and private access roads that will be used to access the turbine sites.

The effect of these activities is limited to the Project Area itself, located in a low population density agricultural area. The effect will also be of limited time at each construction location.

Dust could also affect workers' health and security on the Project Area's unpaved roads and construction sites, namely by increasing particulate matter concentrations, reducing visibility and creating the potential for accidents.

To reduce the effect of dust emissions, the following mitigation measure will be applied:

- Water or a water-based dust suppressant will be used to control dust on Project access roads and utilized public roads within Project limits in summer months;
- Reduced speed traffic on unpaved roads.

Considering the residual effect and the proposed mitigation measures, the residual effect of dust emissions on air quality is of minimal concern and considered not significant (Table 5-2).

5.2.2.2 Fugitive Emissions

The main contributors to criteria air contaminant emissions of the Project will be heavy machinery and truck transportation during the construction and decommissioning phases. Machinery and vehicles will run for the most part on diesel fuel. Emissions generated during construction and decommissioning are considered to be similar to those produced for similar scale construction projects. During operation, fugitive CAC emissions are only associated with maintenance activities which require the use of light trucks. These emissions are considered negligible and not considered further in this assessment.

Assuming displacement of an equivalent amount of power produced from a natural gas or coal plant, the Project would offset significant amounts of CAC emissions. Under these assumptions, it can be stated that the Project would have a positive effect on air quality. Given that the actual displaced energy source is not known, however, it can only be concluded that the Project will have no effect on CAC concentrations.

To reduce CAC emissions, the following mitigation measures will be applied:

- All project and contractor vehicles and machinery will be inspected for compliance with current emission standards.
- During construction and decommissioning, the Project will ensure efficient use of vehicles that will minimize distance traveled and periods of heavy machinery use.

The adverse residual effect on air quality of the Project's CAC emissions is of minimal concern and considered not significant (Table 5-2). Depending on the type of energy displaced, the residual effect could be considered positive.

5.2.2.3 Greenhouse Gases

While a detailed life-cycle assessment has not been done in the context of this environmental assessment, polluting emissions associated with production, construction, operation and decommissioning of wind energy projects (cradle-to-grave) are largely offset by the avoided emissions from producing electricity from wind rather than from fossil fuel. In terms of energy, under normal wind conditions, it takes between two and three months for a turbine to recover all the energy involved in its production, transport, installation and decommissioning (Krohn, 1997).

Assuming displacement of an equivalent amount of power produced from a natural gas or coal plant, the Project would offset approximately 1 200 000 tonnes of CO_2 a year (plus significant amounts of CAC emissions). Under these assumptions, it can be stated that the Project would have a positive effect on global greenhouse gas emissions. Given that the actual displaced energy source is not known, however, it can only be concluded that the Project will have no effect on climate change.

To reduce GHG emissions, the following mitigation measures will be applied:

- All project and contractor vehicles and machinery will be inspected for compliance with current emission standards.
- During construction and decommissioning, the Project will ensure efficient use of vehicles that will minimize distances traveled and periods of heavy machinery use.

The adverse residual effect on air quality of the Project greenhouse emissions is of minimal concern and considered not significant (Table 5-2). Depending on the type of energy displaced, the residual effect could be considered positive.

Table 5-2: Effects Assessment Summary – Air and Climate

Effect	Mitigation Measure	Residual Effect Level	Significance of Effect
Construction and Decommissioning			
Dust Emissions	C1 Water or a water-based dust suppressant will be used to control dust on Project access roads and utilized public roads within Project limits. C2 Speed of traffic will be reduced on unpaved roads.	Minimal	Not significant
Fugitive emissions (except CO_2)	C3 Trucks and machinery will be inspected for compliance with emission standards. C4 Efficient transportation will be maintained as much as possible during construction and decommissioning.	Minimal	Not significant
Greenhouse gases		Minimal	Not significant
Operation			
Reduction of CACs and GHGs	-	Potentially Positive	-
Accident and Malfunctions			
None	-	-	-

5.2.3 Follow-up and Monitoring

Considering the minimal adverse residual effects that the Project is expected to have on air quality, no follow-up or monitoring programs have been proposed or are considered necessary.

5.3 Terrain, Geology, Soils and Drainage

5.3.1 Introduction and Scoping

Construction activities, including road building, soil stripping and grubbing, and excavation at turbine sites, have the potential to interact with the terrain and soil resources both within and beyond the immediate footprint of the Project (Table 5-3).

The Project-related effects on this environmental component are the following:

- Change in terrain drainage;
- Change in terrain stability;
- Change in soil compaction;
- Soil contamination from oil or fuel spills.

5.3.2 Effects Assessment

5.3.2.1 Change in Terrain Drainage

Probably one of the most important factors affecting long-term agricultural land use in the region is maintenance of the intricate network of surface drains. The clayey soils have slow to very slow permeability, high shrink-swell properties and are very plastic. They are subject to surface ponding and slow runoff unless adequate drainage is provided. The construction of new access roads will affect existing surface drains and ditches, which may have an effect on terrain drainage.

In order to avoid disturbing existing terrain drainage, the following mitigation measures will be undertaken:

- Confirm existing drainage conditions through investigation prior to access road construction;
- Restore disturbed areas (e.g. vegetated or reseeded with appropriate seed mix; recontoured to complement pre-construction/decommissioning drainage patterns, etc.);
- Install adequately designed culverts and surface drains for all new access roads.

Assuming the application of these mitigation measures, the residual effect is considered minimal and not significant.

5.3.2.2 Change in Terrain Stability

Parameters used to assess terrain stability are thickness and quality of surface deposits, bedrock quality and surface water and groundwater conditions. Surface and subsurface investigations, test pits and/or boreholes have been conducted to assess regional conditions. More detailed investigations will be conducted prior to construction.

Given the thickness of the surface deposits in the region, it is unlikely that blasting will be required for excavating at turbine sites. It is also unlikely that extensive dewatering will be required due to the generally low soil permeability.

Mitigation measures for terrain stability and surface erosion include:

- Conduct a geotechnical investigation prior to any soil/rock excavation and blasting. In the event that the geotechnical assessment determines that one or more turbine locations are not suitable, consideration will be given to alternate locations. All alternate locations will be within the Project Area, and will comply with all constraints as per this layout scenario (setbacks, noise levels, avoiding woodlots, etc.);

- Confirm information about soil quality, drainage and groundwater conditions at turbine and road locations through subsurface investigations.

Assuming the application of these mitigation measures, the residual effect is considered minimal and not significant.

5.3.2.3 Change in Soil Compaction

Soil compaction occurs when soil particles are pressed together, reducing pore space between them. As the pore space is decreased within a soil, the bulk density is increased. The repetitive passing of construction machinery and trucks on agricultural land may have effects on soil compaction. This effect will be limited to the areas used for access roads and turbine locations, i.e. 368 ha or approximately 1.7% of the Project Area during construction, and 186 ha or 0.9% of the Project Area during operations. It is not an issue to be considered outside the construction and operation footprints tabulated in Table 2-6.

Soil compaction mitigation practices will be undertaken at two instances: after the construction phase – on what is referred to as the temporary footprint – and at the decommissioning phase. Mitigating the effects of soil compaction includes the measures described below.

- Access road width will be limited to 5 m during operation and working areas at turbine sites (rotor assembly areas) will be restored. Excess road width and temporary working areas required during construction is to be tilled and turned over immediately after construction in an effort to restore soil density and return these surfaces to agriculture in the first year of commissioning.
- After the decommissioning of the Project, all access roads and footprints on agricultural land will be restored to their natural state through the site reclamation strategy.

Assuming the application of these mitigation measures, soil density will be returned to its initial state in most temporary surfaces, limiting the compacted areas to the surfaces occupied by the Project during operation, i.e. 186 ha or 0.9% of the Project Area. The residual effect is considered minimal and not significant.

5.3.2.4 Contamination of Soils or Groundwater from Oil and Fuel Spills

Spills may occur due to an accident or malfunction during construction activities, operation, and decommissioning.

Mitigation measures include:

- Train the construction and maintenance crews to respond to accidental spills;
- Equip all project vehicles with an emergency spill response kit;
- Inspect truck and heavy machinery on a regular basis;
- Establish secure designated refuelling areas and maintenance areas.

As indicated in Section 3, the soil conditions, i.e. heavy texture, low permeability and slow drainage, reduce the risk of deep leaching of potential contaminants on the soil surface. Given the small quantities possibly involved and the planned mitigation measures proposed, the potential residual effects on soil and on groundwater due to accidental oil or fuel spills are of minimal concern and not significant.

Table 5-3: Effects Assessment Summary – Terrain, Soils and Groundwater

Effect	Mitigation Measure	Residual Effect Level	Significance of Effect
Construction			
Change in terrain drainage and stability, and soil compaction	C5 Geotechnical investigation will be conducted prior to any soil/rock excavation and blasting. C6 Information on soil quality, drainage and groundwater conditions at turbine and road locations will be obtained through subsurface investigations. C7 Disturbed areas will be restored (e.g. vegetated or reseeded with appropriate seed mix; recontoured to compliment pre-construction drainage patterns, etc.). C8 Salvaged subsoil will be replaced and capped with topsoil and salvaged organic material, including woody debris. C9 Adequately designed culverts and surface drains will be installed for all new access roads. C10 Sediment and erosion control measures will be implemented as required in areas of erosion risk. C11 Soil tillage practices and overturning on compacted soil will be implemented.	Minimal	Not significant
Operation			
Change in terrain drainage and stability, and soil compaction	O1 Access roads width will be limited to 5 m at turbine sites and turbine sites will be restored. O2 Excess road width and temporary working areas will be tilled and turned over after construction.	Minimal	Not significant
Decommissioning			
Change in terrain drainage and stability, and soil compaction	Same as C8, C10, and C11	Minimal	Not significant
Accidents and Malfunctions			
Contamination of soils or groundwater from oil and fuel spills	A&M1 Contractor will have an Emergency Response Plan (ERP) in place in accordance with the Environmental Management Plan (EMP). A&M2 All crews will be trained on proper implementation of the ERP, including accidental spills response. A&M3 All crews will have spill clean-up materials on hand at all times. A&M4 Trucks and heavy machinery will be inspected on a regular basis to minimize the potential for accidental releases of toxic fluids (hydraulic fluids, coolant, etc). A&M5 Designated refuelling/maintenance areas will be environmentally secure and located away from watercourses and waterbodies. A&M6 Hazardous materials will be stored in designated secure areas. A&M7 Operational control procedure for storage and handling of hazardous materials will be implemented and all construction staff will be trained on proper implementation of this procedure.	Minimal	Not significant

5.3.3 Follow-Up and Monitoring

Considering the minimal residual effects that the Project is expected to have on terrain drainage, soil compaction or contamination, no specific monitoring programs have been proposed or are considered necessary. However, an environmental monitor will be present on site, during construction and decommissioning activities, to ensure that all measures are applied to limit any potential effects. As a follow-up measure, landowners will be consulted after construction to ensure no effects from the construction activities remain.

5.4 Aquatic Habitats

5.4.1 Introduction and Scoping

The aquatic habitats in the Project Area are summarized in Section 3.4 of this report. Within the study area, the majority of the aquatic habitats are situated in agricultural drains, the Buffalo Channel, and the Rivière aux Marais. The primary importance of these habitats stems from their connection to the larger Red River drainage system. There are also some isolated ponds in the Project Area. These provide habitat for aquatic organisms, but their lack of connectivity makes their importance secondary to the drains.

5.4.1.1 Legislation and Policy

Section 35 (2) of the federal *Fisheries Act* protects aquatic habitats by requiring that there be no net loss of fish habitat. A harmful effect on habitat is described as a Harmful Alteration, Disruption, or Destruction of fish habitat (HADD). Any HADD requires an Authorization from Fisheries and Oceans Canada (DFO). DFO's risk management approach is to find ways to avoid the HADD by relocation or redesign of the proposed undertaking, or by employing design and construction mitigation measures. If the mitigation strategy does not fully address all the anticipated impacts, habitat enhancement projects may be considered as compensation for lost habitat. The objective in the development of a compensation strategy is to provide for no net loss to the productive capacity of the aquatic habitat.

The Manitoba Department of Water Stewardship (Fisheries Branch) works with DFO to review applications for authorizations under the *Fisheries Act*. The approval process includes the submission of an application to DFO, and to the Manitoba Policy and Coordination Branch where the application is screened and forwarded to the relevant provincial agencies for review (Bruederlin 2008).

The application includes supporting documentation that constitutes the proposed plan. Following review and negotiations, an Authorization or a letter of advice is then prepared and given final approval by DFO. Various types of monitoring are often a condition of an Authorization. The federal *Species at Risk Act* also affords protection of the habitats of significant aquatic species, and applicability of the Act is screened during the review of the submission package.

In addition, there are provincial policies and legislation that apply to watercourses and waterbodies. The *Endangered Species Act* protects endangered and threatened species in the province. The *Rivers and Streams Act* provides protection to any river or stream in the province, and prohibits the deposition of material that would inhibit stream flow or compromise the stability of the banks. The *Water Rights Act* applies to the construction or operation of some water control works. These three items of legislation are administered by Manitoba Conservation and Manitoba Water Stewardship (DFO & Manitoba DNR 1996).

The *Planning Act* is administered by the Department of Municipal Affairs, and includes protection and conservation of lakes, rivers and shore lands. The *Manitoba Environment Act*, administered by Manitoba Environment, includes a licensing process for developments that are likely to significantly affect the environment. The licence, issued by Manitoba Environment, often includes fish and fish habitat measures. Stream crossings constructed on Crown lands involve a work permit, often required under an *Environment Act* Licence. Such work permits are issued by the Natural Resources Officer of the District in which the project is occurring. A work permit may apply to provincially maintained drains (DFO & Manitoba DNR 1996).

Finally, timing windows for in-stream work have been outlined by DFO for southern Manitoba. Timing windows ensure that work is not conducted during critical life stages of fish, specifically spawning, egg incubation and early life development. Typical timing windows prohibit in-stream work for several months in early or late spring for warm-water habitats. Cold-water habitat windows can prohibit work during spring, winter or fall, or a combination of these seasons. The exact timing windows are based on the species present. Some information on timing windows is provided in the *Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat*, but the Regional Fisheries Manager should be consulted to determine the appropriate window (DFO & Manitoba DNR 1996).

5.4.2 Potential Effects

For the Project, the layout of turbines and access roads has been designed to minimize impacts to aquatic habitats. Impacts to aquatic habitat will be limited to new road crossings and upgrades to existing crossings. A total of 39 potential new road crossing locations have been identified. As a result, the following potential effects on aquatic habitat may be encountered during construction and decommissioning phases of the Project:

- Direct impacts from crossing;
- Barriers to movement;
- Sedimentation;
- Contaminant spills.

5.4.3 Effects Assessment

5.4.3.1 Direct Impacts from Crossing

Aquatic habitat can be affected by the physical loss of habitat at a watercourse crossing. Thirty-nine potential new road crossing locations have been identified where access roads could cross agricultural drains. These crossing locations are outlined in Table 5-4 and shown in Map 3-2. It is to be noted that the final watercourse/drain crossing locations will be determined at the construction planning stage and that an additional effort will be made to reduce their number.

There are also locations where existing crossings on minor roads may require improvements prior to use by large and/or heavy vehicles. Although the specific improvement locations had not been confirmed at the time of writing, alterations to existing structures are subject to the same mitigation measures and permitting process as the new crossing locations.

Table 5-4: Watercourse Crossings

Crossing	Access to Turbine #	Watercourse	Habitat Characteristics
CKC-001	8	drain	• 20-m corridor of grass • 6 m wide channel • bank vegetation: herbaceous • channel vegetation: cattails • slow flow on April 22, 2008
CKC-002	10	drain	• 10-m corridor of grass and other herbaceous plants • 4 m wide channel • bank vegetation: herbaceous • channel vegetation: emergent aquatic grass • standing water on July 24, 2007
CKC-003	11 and 12	drain	• 15-m corridor of grass • 2 m wide channel • bank vegetation: grass • channel vegetation: cattails • standing water on April 22, 2008
CKC-004	21, 22, 23	Buffalo Channel (south channel)	• 40-m corridor of grass • 8 m wide channel • bank vegetation: herbaceous • channel vegetation: rushes, cattails • standing water on July 25, 2007
CKC-005	28, 29	drain	• 20-m corridor of grass and other herbaceous vegetation

Crossing	Access to Turbine #	Watercourse	Habitat Characteristics
			• 5 m wide channel • bank vegetation: herbaceous • channel vegetation: herbaceous • no water on July 24, 2007
CKC-006 CKC-007	30 31	drain	• 10-m corridor of grass & other herbaceous plants • 4 m wide channel • bank vegetation: grass, other herbaceous • channel vegetation: grass • no water on 24 July, 2007
CKC-008 CKC-009 CKC-010	35 36 37	drain drain drain	• 6-m corridor of grass • 1.5 m wide channel • bank vegetation: grass • channel vegetation: grass, rushes • standing water on April 22, 2008
CKC-011	39	drain	• 5-m corridor of grass • 1 m wide channel • bank vegetation: grass • channel vegetation: grass • standing water on April 22, 2008
CKC-012 CKC-013	40 41	drain	• 5-m corridor of grass • 1 m wide channel • bank vegetation: grass • channel vegetation: grass, cattails • standing water on April 22, 2008
CKC-014 CKC-015	50 51	drain	• 8-m corridor of herbaceous vegetation • 3.5 m wide channel • bank vegetation: herbaceous • channel vegetation: herbaceous • no water on July 24, 2007
CKC-016 CKC-017	52 53	drain	• 8-m corridor of herbaceous vegetation • 6 m wide channel • bank vegetation: herbaceous • channel vegetation: herbaceous • standing water on July 24, 2007
CKC-018	46 to 49	drain	• 10-m corridor of grass • 4 m wide channel • bank vegetation: grass • channel vegetation: cattails • standing water on April 22, 2008
CKC-019	55	drain	• 6m wide corridor of herbaceous vegetation • 4m wide channel • bank vegetation: herbaceous • channel vegetation: herbaceous • no water on July 24, 2007
CKC-020 CKC-021	82 83	drain	• 6-m corridor of mowed grass • 2.5 m wide channel • bank vegetation: grass • channel vegetation: grass • flowing water on April 22, 2008
CKC-022	66 to 70	drain	• 10-m corridor of grass • 4 m wide channel • bank vegetation: grass • channel vegetation: grass, cattails • standing water on April 22, 2008
CKC-023 CKC-024	94 95	drain	• 6-m corridor of grass • 3 m wide channel • bank vegetation: grass

Crossing	Access to Turbine #	Watercourse	Habitat Characteristics
CKC-025	96		• channel vegetation: grass, cattails • slow flow on April 22, 2008
CKC-026	105	drain	• 8-m corridor of grass and other herbaceous plants • 2 m wide channel • bank vegetation: grass, other herbaceous • channel vegetation: grass
CKC-027	106	drain	• 6-m corridor of grass • 2 m wide channel • bank vegetation: grass • channel vegetation: shrubs • standing water on April 22, 2008
CKC-028	107	drain	• 6-m corridor of grass • 2 m wide channel • bank vegetation: grass, shrubs • channel vegetation: cattails • standing water on April 22, 2008
CKC-029	108	drain	• 6-m corridor of grass and shrubs • 2.5 m wide channel • bank vegetation: grass, shrubs • channel vegetation: cattails • standing water on April 22, 2008
CKC-030 CKC-031	126 127	drain	• 8-m corridor of grass • 2 to 3 m wide channel • bank vegetation: grass • channel vegetation: cattails • standing water on April 22, 2008
CKC-032	162	drain	• site-specific information not obtained
CKC-033	163	drain	• site-specific information not obtained
CKC-034	164	drain	• site-specific information not obtained
CKC-035 CKC-036	168 169	drain	• 8-m corridor of grass • 3 m wide channel • bank vegetation: grass • channel vegetation: cattails, grass • standing water on April 21, 2008
CKC-037 CKC-038 CKC-039	172 173 174	drain	• 10-m corridor of grass • 3 m wide channel • bank vegetation: grass • channel vegetation: cattails, grass • standing water on April 21, 2008

For the agricultural drains that are being crossed, the uniformity of habitat, the consistency of flow, and the proximity and connection to major water bodies such as the Buffalo Channel and the Rivière aux Marais affect the importance of the habitat as it relates to the fishery resources. The use of a standard pipe or box culvert will have the effect of eliminating an area of aquatic habitat. The effect can be partially mitigated by replanting vegetation in the corridor both upstream and downstream of the crossing to limit the area that remains affected after construction. Correct sizing of the culvert and countersinking into the substrate also provides some mitigation, thus limiting the extent of the residual effect.

Direct impacts can also occur as a result of impediment to flow. Most locations where a new access road connects to an existing road will require a conveyance structure that is adequate to convey foreseeable flows in the roadside ditch or drain. This applies to most roadside ditches and the new crossings shown in Map 3-2.

Lastly, there are locations where the electrical cabling crosses watercourses. Some of these locations coincide with road crossings, and some are located away from roads. In order to minimize the impact of this component of the crossing, the cabling will be incorporated into a road bed, installed under the watercourse using directional bore technology, or suspended on poles as above-ground lines. An open trench approach may also be an option, especially if an intermittent drain is not flowing during construction. Regardless of the road and/or cabling crossing design used, all crossing designs will be reviewed with respect to the federal *Fisheries Act* by DFO and Manitoba Water Stewardship (Fisheries Branch).

The general mitigation measures are outlined in Table 5-5 apply to road crossings and cabling crossings. In addition, the *Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat* is a helpful resource that outlines best practices for stream crossings (DFO & Manitoba DNR 1996).

The various permitting processes, in particular the *Fisheries Act* negotiations with DFO and Manitoba Water Stewardship (Fisheries Branch), will ensure that effects on aquatic habitat are identified and mitigated and/or compensated such that the crossings are in compliance with the applicable policies and legislation. Specific concerns regarding significant species will also be addressed in this way. Therefore, the level of concern is minimal and the anticipated residual effects will not be significant.

5.4.3.2 Barriers to Movement

The crossings discussed above have the potential to impede or obstruct upstream movement of aquatic organisms through the culvert. It is important to mitigate the potential effect by correctly installing the culverts such that they are countersunk (typically at least 10% of culvert diameter) into the channel substrate to avoid creating a vertical barrier. In addition, limiting the length of the culvert and installing the culvert with minimum or no slope provides further mitigation of this effect. The *Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat* outlines good practices for fish passage (DFO & Manitoba DNR 1996).

The above mitigation measures will ensure that the crossings have practically no residual effect on the movement of aquatic organisms. Therefore, the level of concern is minimal, and the anticipated residual effect is deemed not significant.

5.4.3.3 Sedimentation

The effects of erosion and sedimentation are a concern wherever construction is in close proximity to the drains, creeks and rivers, and during the construction of the crossings discussed above and shown in Map 3-2.

Bare soils will be exposed during site prospecting, construction of the access road, preparation of concrete foundations and the installation of the electrical network, as well as during the removal of these components during decommissioning. Rainfall and surface water runoff will result in erosion of exposed soils and potential movement of sediment-laden runoff to waterbodies. Other drilling by-products such as extracted soil cores may also result in sedimentation. Sediment can negatively alter the aquatic habitat in any waterbody, and adversely affect the existing erosion and sediment transport regimes of watercourses. With the exception of the crossing locations, construction activities will respect a 15-m buffer from the top-of-bank of the drains. General mitigation measures are included in Table 5-5.

At the crossing locations, the in-water work required has a high potential to release sediment into the watercourse downstream. The mitigation measures include installing the culverts when flows are low or absent. It is also recommended that work be done in dry conditions using accepted methods to bypass flows such as damming and pumping the water around the in-water construction area or using a diversion channel. Details on these and other mitigation measures are given in the *Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat* (DFO & Manitoba DNR 1996).

The potential for rare species in the large aquatic habitat features and the intermediate drains makes it especially important that erosion is prevented and sediment is contained. Adherence to the mitigation measures provided in Table 5-5 will make it unlikely that levels of sedimentation impacting aquatic habitat will occur. Should sediment enter a watercourse under normal weather and flow conditions, most of the sediment is expected to settle to the channel bottom in relatively close proximity to the release point. The level of concern is therefore low, and the anticipated residual effect will not be significant.

5.4.3.4 Contamination from Spills

During the construction and decommissioning phases, the potential for hazardous material spills must be considered. This potential effect should be given particular attention at the new access road crossings and any existing road crossings of watercourses that will be used to transport hazardous materials to and from work sites.

Spills will be minimized by ensuring that proper industry regulations are followed. Refuelling of construction equipment will only take place at crane pads or designated areas, well away from running water. Hazardous materials will be stored off site. Emergency spill kits will be maintained on the project site, to be used in the event that any spills of hazardous material should occur.

Watercourses have potential to convey hazardous materials for long distances and affect large areas of habitat; the best mitigation is to prevent spills from occurring. The recommended mitigation measures will ensure that the likelihood of a spill entering a watercourse is low. As a result, the level of concern is minimal and the anticipated residual effect will not be significant.

Table 5-5: Effects Assessment Summary – Aquatic Resources

Effect	Mitigation Measure	Residual Effect Level	Significance of Effect
Construction			
Direct impacts from crossing	C12 Activities near watercourses and waterbodies will be conducted according to federal and provincial regulations and guidelines. C13 Whenever trees and shrubs are removed from watercourse corridors at crossing locations, they will be replanted on upstream and downstream sides of the crossings in order to minimize the extent of the effect.	Minimal	Not Significant
Barriers to movement	C14 Culverts will be countersunk below the level of the substrate to avoid creating a vertical barrier at the outlet of the pipe. C15 Culvert lengths and their slope will be kept to a minimum.	Minimal	Not Significant
Sedimentation	C10 Sediment and erosion control measures will be implemented as required in areas of erosion risk. C16 A 15-m buffer from the top-of-bank of any drain, creek or river will be respected such that no other than construction (or decommissioning) activity occurs in the buffer. C17 Timing windows for in-water works will be respected. C18 Culverts will not be installed when flows are high. C19 Culvert installation will use accepted methods for working in dry conditions. C20 Electricity transmission line crossings will either be incorporated into the road bed, employ a directional bore method, be installed as overhead lines, or be installed with trenching methods in the absence of flow. C21 Standard sediment and erosion controls will be implemented and maintained for the duration of the disturbance. C22 An Environmental Management Plan (EMP) will be implemented as guidance for the contractor to minimize environmental impacts. C23 All site staff will be trained on implementing the plans and procedures contained within the EMP. C24 Settling ponds or filter bags will be used to remove sediment prior to discharge of water where necessary.	Low	Not Significant
Operation			

None	-		
Decommissioning			
Sedimentation	Same as C10, C16 C17, C21, C22, C23, and C24	Minimal	Not Significant
Accidents and Malfunctions			
Contamination from spills	A&M1 Contractor will have an Emergency Response Plan (ERP) in place in accordance with the Environmental Management Plan (EMP). A&M2 All crews will be trained on proper implementation of the ERP, including accidental spills response. A&M3 All crews will have spill clean-up materials on hand at all times. A&M4 Trucks and heavy machinery will be inspected on a regular basis to minimize the potential for accidental releases of toxic fluids (hydraulic fluids, coolant, etc). A&M5 Designated refuelling/maintenance areas will be environmentally secure and located away from watercourses and waterbodies. A&M6 Hazardous materials will be stored in designated secure areas. A&M7 Operational control procedure for storage and handling of hazardous materials will be implemented and all construction staff will be trained on proper implementation of this procedure.	Minimal	Not Significant

5.4.4 Follow-up and Monitoring

5.4.4.1 Construction Phase Monitoring

Environmental supervision during construction as part of a routine inspection program will be implemented to ensure adherence to the prescribed mitigation measures. Environmental supervision is especially recommended during construction of watercourse crossings.

Monitoring will be carried out routinely to ensure soil stabilization and early identification of erosion and sedimentation.

5.4.4.2 Operation Phase

None warranted.

5.4.4.3 Decommissioning Phase

Environmental supervision during decommissioning as part of a routine inspection program is recommended to ensure adherence to the prescribed mitigation measures. Environmental supervision is especially recommended during removal of watercourse crossings.

Monitoring will be carried out routinely to ensure soil stabilization and early identification of erosion and sedimentation.

5.5 Vegetation

5.5.1 Introduction and Scoping

The vegetation communities within the Study Area have been summarized in Section 3.5 of this report. The majority of the Study Area is dominated by active agricultural fields, with scattered deciduous hedgerows and corridors of deciduous woodland associated with riparian areas. Two natural habitats and two culturally influenced habitats were documented within the Study Area, representing four different community types. In addition to vegetation communities, all hedgerows within the Study Area were documented and classified based on dominant vegetation types. A total of 131 hedgerows within the Study Area were recorded and mapped. In order to assess the potential impacts of this Project on the vegetation, the location and characteristics of the vegetation communities were compared with activities proposed in the construction, operational, and decommissioning phases of this Project. Background review revealed that no designated natural areas or protected areas, including Wildlife Management Areas, are present within the proposed Study Area, and therefore no impact will occur within any designated natural area.

The layout of turbines, access roads, and transmission facilities was designed so as to avoid direct impacts to natural vegetation communities and hedgerow habitats. Indirect impacts on vegetation due to on-site activities have also been examined and addressed, including the creation of bare soils. In this section of the report, these potential indirect effects on vegetation are discussed, along with recommended mitigation measures and additional monitoring.

Access roads have been proposed such that three hedgerows will be crossed by proposed access roads. These three roads are located between WTG 144 and WTG 145, WTG 180 and WTG 181, and WTG 192 and WTG 193. Crossings by proposed transmission lines have also been examined, and a total of 28 potential hedgerow crossings will occur by proposed transmission lines, including both underground and overhead transmission lines. Seventeen of these transmission line hedgerow crossings are by underground cables, and the remaining eleven crossings are by overhead wires. Some of the potential crossing locations by overhead wires are expected to be situated immediately along existing roadways, with little impact to existing hedgerow habitat. The placement of the access road and transmission lines may result in the removal of no more than 0-5 trees at each of the crossing locations. In several locations, proposed access roads and transmission lines run adjacent to deciduous hedgerows or existing roadways without any proposed crossing. These access roads are proposed to have minimal direct impact to adjacent hedgerow habitat. In any areas where vegetation is to be removed, detailed vegetation assessments will be completed upon the finalization of construction details. This work will be very focused, only occurring in areas where vegetation removal is required. These areas, if any, will be detailed upon finalization of access road layouts and other construction details.

The following potential effects may be encountered during the construction and decommissioning phases of this Project:

- Sedimentation;
- Vegetation clearing;
- Contamination from spills (accidents and malfunctions).

5.5.2 Effects Assessment

5.5.2.1 Sedimentation

Bare soils will be exposed during site prospecting, construction of the access road, preparation of concrete foundations and installation of the electrical network, as well as during the removal of these components during decommissioning. As most of the lands being used for these activities are actively tilled, they are currently bare for portions of the year. Rainfall and surface water runoff will result in erosion of soils and sediment-laden runoff potentially entering natural areas. Other drilling by-products such as extracted soil cores may also result in sedimentation. Potential residual effects to vegetation are expected to be low, as appropriate sediment and erosion control measures are available with proven track records of sediment control. The proposed turbines are all found at considerable distances from forested and wetland habitats, the closest being 300 m from a vegetation community, and only two other proposed turbines within 500 m of a vegetation community. Moreover, mitigation measures will be applied (Table 5-6) in order to reduce any potential effect. Given these measures, the residual effect level of concern is classified as minimal and not significant.

5.5.2.2 Vegetation Clearing

During the construction phase, access roads are proposed to cross existing hedgerows at three locations, and proposed transmission lines will cross hedgerows at 28 locations. The hedgerows that are proposed to be crossed have all been classified as deciduous hedgerows. Limited vegetation clearing may occur, and is anticipated to affect between 0-5 trees at each of the 31 potential crossings. Proper arboreal practices will be utilized during the removal or pruning of any tree. Any limbs or roots of trees to be retained that are damaged during the construction phase will be pruned using proper arboricultural techniques. Given these measures, the residual effect level of concern is classified as minimal and not significant.

5.5.2.3 Contamination from Spills

During the construction and decommissioning phases, the potential for hazardous material spills must be considered. Spills will be minimized by ensuring that proper industry regulations are followed. Refuelling of construction equipment will only take place at crane pads or designated areas. Hazardous materials will be stored off-site. Emergency spill kits will be maintained on the Project site, to be used in the event that any spills of hazardous material should occur. Limited effects on vegetation are expected, due to the storage of hazardous material off site and the distance between work areas and stands of vegetation. The effects of potential spills or uncontrolled release of deleterious substances are expected to be fairly localized and mitigation measures would allow for rapid clean up and restoration. Therefore, the residual effect level of concern is classified as minimal and not significant.

Table 5-6: Effects Assessment Summary – Vegetation

Effect	Mitigation Measure	Residual Effect Level	Significance of Effect
Construction			
Sedimentation	C10 Sediment and erosion control measures will be implemented as required in areas of erosion risk. C22 An Environmental Management Plan (EMP) will be implemented as guidance for the contractor to minimize environmental impacts. C23 All site staff will be trained on implementing the plans and procedures contained within the EMP. C24 Settling ponds or filter bags will be used to remove sediment prior to discharge of water where necessary.	Minimal	Not significant
Vegetation Clearing	C25 Vegetation clearing will be used only when necessary and will be limited to hedgerow habitats. C26 Proper arboricultural techniques will be used in the removal or pruning of any tree, including limbs and roots.	Minimal	Not significant
Operation			
None	-		
Decommissioning			
Sedimentation	Same as C10, C22, C23, and C24	Minimal	Not significant
Accident and Malfunctions			
Contamination from spills	A&M1 Contractor will have an Emergency Response Plan (ERP) in place in accordance with the Environmental Management Plan (EMP). A&M2 All crews will be trained on proper implementation of the ERP, including accidental spills response. A&M3 All crews will have spill clean-up materials on hand at all times. A&M4 Trucks and heavy machinery will be inspected on a regular basis to minimize the potential for accidental releases of toxic fluids (hydraulic fluids, coolant, etc). A&M5 Designated refuelling/maintenance areas will be environmentally secure and located away from watercourses and waterbodies. A&M6 Hazardous materials will be stored in designated secure areas. A&M7 Operational control procedure for storage and handling of hazardous materials will be implemented and all construction staff will be trained on proper implementation of this procedure.	Minimal	Not significant

5.5.3 Follow-up and Monitoring

5.5.3.1 Construction and Decommissioning Phase

Environmental supervision during construction as part of a routine inspection program will be implemented to ensure adherence to the prescribed mitigation measures. Environmental supervision is especially recommended during key components of the construction phase.

Monitoring will be carried out routinely to ensure soil stabilization and early identification of runoff and erosion.

5.5.3.2 Operation Phase

None warranted.

5.6 Avian Fauna

5.6.1 Introduction and Scoping

Wind farms are known to pose threats to avian wildlife, particularly birds and bats. Kingsley and Whittam (2007) described the three potential threats facing these species, including direct fatalities, disturbance, and habitat loss (Environment Canada 2007). Direct fatalities can be associated with a number of wind farm characteristics, including configuration, height and elevation, guy wires, lights, motion smear, and transmission lines. Indirect threats include habitat loss, waste, decommissioning, and site placement near water or areas of food concentration (Environment Canada 2007).

Environment Canada (2007) reported that objects over 150 m in height are a greater threat to bird populations, particularly nocturnal migrants. These structures, including communication towers, tall buildings, and wind turbines, also have a greater threat of mass bird kills. Most wind turbines are between 60-120 m in height, and therefore do not reach the critical height defined by Environment Canada. There are relatively few reports of mortality events (greater than a few birds) at communications structures or wind facilities less than 150 m in height (Erickson et al. 2001).

Environment Canada (2007) indicated that underground transmission lines may reduce bird collision fatalities, but that the habitat loss required for the installation of these may be substantial. In areas where the risk of collision is relatively low and sensitive habitats are present, overhead lines are recommended. However, in areas not deemed sensitive habitat or with high risk of transmission line collision, placing lines underground may be warranted. In most cases interconnection lines are buried along access roads and do not result in additional disruption of habitats.

Results from modern wind farms indicate that an average of 2.19 avian fatalities per turbine per year has been observed in the United States. If raptor interactions are excluded, avian fatalities would represent only 0.033 fatalities per turbine per year (Erickson et al. 2001). If California is excluded, both of these averages drop substantially to 1.83 and 0.006 fatalities per turbine per year, respectively. Studies of individual wind farms in the north-eastern United States have shown similar, and often lower, annual mortality averages. Erickson et. al. (2001) examined the Buffalo Ridge wind facility, that averaged 1.95 fatalities per turbine per year, most of which were found to occur near wetlands and woodlands. Another wind facility in Searsburg, Vermont was found to have no recorded bird fatalities during one full one year study (Kerlinger 2000).

The assessment of environmental effects on bats considered the three project phases, including site preparation and construction, operation, and decommissioning. The specific potential effects on birds include:

- Disruption of bird nests;
- Habitat loss;
- Disturbance of bird behaviour;
- Bird collisions with turbines and power lines.

5.6.2 Effects Assessment

5.6.2.1 Disruption of Bird Nests

The *Migratory Birds Convention Act* prohibits the disruption of birds and their nests. Limited vegetation clearing is proposed to occur during the construction phase, and is anticipated to affect no more than 5 trees at each proposed crossing, or a total of less than 155 trees, all located in hedgerow habitat. As a result of this very limited vegetation clearing during the construction phase of this project, the disruption of bird nests is very unlikely. The disruption of bird nests is only an issue for a relatively short period of time, i.e. within the potential time overlap of the nesting period of local avifauna and the various construction activities. Vegetation clearing and construction near natural communities should be avoided, if possible, during the period of breeding bird and nesting activity. This time period is generally accepted to occur in wooded habitats from late May through late July.

Based on the assessment that the extent of vegetation clearing will be limited, and confined to hedgerow habitat, loss of bird productivity is not anticipated. The residual level of concern is therefore considered to be minimal and not significant. Furthermore, once the lands are cleared, the *Migratory Birds Convention Act* is unlikely to apply, as these lands would not provide habitat for nesting.

5.6.2.2 Habitat Loss

Up to 31 deciduous hedgerows may be affected during the construction phase of this project. Three crossings will occur as a result of proposed access roads, and another 28 potential crossings may result from proposed transmission lines. Each proposed crossing will result in an anticipated effect on between 0-5 trees at each of the crossing locations. These trees may provide limited cover or perching habitat for individual birds, but are not anticipated to affect significant habitats for local bird populations. As part of the detailed vegetation survey, trees to be removed will also be assessed for large stick nests. As per Manitoba Hydro's Environmental Protection Guidelines (2006), any trees with large sticks nests will be left undisturbed and reported to the appropriate authority. The resulting effect of the limited loss of hedgerow habitat is expected to be low and not significant.

5.6.2.3 Disturbance of Bird Behaviour

Kingsley and Whittam (2007) indicate that disruption of bird behaviour may potentially be one of the greatest effects of wind power projects. In addition to disruption of nests (discussed above), Kingsley and Whittam (2007) note that disruption of flight patterns as well as disturbance caused by turbines and human activities may be an issue. However, they also note that "although not a subject of many studies, impacts to avian productivity do not appear to be affected by wind facilities". The potential habitat in the vicinity of the turbines is very low. The distances to remnant stands of natural vegetation are considerable, with only three turbines within 500 m of a natural community or isolated woodlot, and none closer than 300 m to these habitats. The nearby shoreline of the Red River may provide an attractive habitat for birds, and is known to concentrate migrating birds along the shoreline. The nearest proposed turbine is approximately 1.1 km from the river.

Another potential disturbance to bird behaviour includes the barrier effect, leading to bird avoidance of the area. The risk of bird avoidance is dependant on a variety of factors including bird species, flight height, turbine layout, time of day, and wind speed and direction (Drewitt and Langston 2006). Studies of bird flight patterns through and around wind farms suggests that birds are able to detect the hazards associated with operational turbines and will either fly between turbines or fly around the wind farm altogether (Black 2005; Osborn et al 1998). The greatest threats to bird populations in terms of potential barriers is reflected in the placement of turbines between nesting and foraging areas, or additional energy costs resulting from cumulative effects of many wind farms creating a linear barrier to movement (Drewitt and Langston 2006).

Based on the proposed turbine layout of the Project, turbines will be placed in agricultural habitats, and will not be found between large woodlots. As a result of overall bird observations, flight patterns, and turbine layouts, the potential disturbance of bird behaviour is anticipated to be low and not significant.

5.6.2.4 Bird Collisions with Turbines and Powerlines

The operation of turbines and the potential for collisions of birds with turbines and the above-ground powerlines are a consideration.

A maximum of 200 turbines will be operational in the Project. In addition, a total of 15.5 km of overhead powerlines along municipal roads will be required. Results from modern wind farms indicate that an average of 2.19 avian fatalities per turbine per year have been observed in the United States (Erickson et al 2001). This number is relatively low when compared to bird fatalities associated with other structures such as buildings and communication towers. Erickson et al (2001) suggests that only 0.01 to 0.02% of all collision-related bird fatalities are a result of modern wind turbines. Additionally, results of a two-year post-construction avian monitoring program at the Erie Shores Wind Farm in Ontario show a mortality rate of approximately 1.2 to 2.5 birds per turbine per year (James, 2007).

The lighting of turbines can have an impact on birds, especially nocturnal migrants. Solid red or flashing red lights should be avoided as they appear to attract nocturnal migrants more than white flashing lights (U.S. Fish and Wildlife Service 2003). These lights also appear to disrupt nocturnal migrants (causing circling or hovering behaviour) at a much higher rate than white flashing lights (Gauthreaux and Belser, 1999, Gauthreaux, 2000).

Transport Canada produced minimum guidelines for structure lighting to address safety issues. Environment Canada (2007) has recommended that wind turbines utilize the minimum lighting allowable by Transport Canada. This would correspond to a long “off-phase” and a very short flash duration. Continuous lighting and spotlights have been shown to attract and confuse birds, ultimately leading to injuries and fatalities (Environment Canada 2007).

Bird monitoring in 2007 and 2008 found that bird use of the Project Area was relatively low. The proposed turbines are also set back from the shoreline of the Red River and any significant vegetated areas. Based on extensive field work and background review, a low incidence of bird collisions with turbines and overhead power lines is anticipated. The residual level of concern is therefore considered to be low and not significant.

Table 5-7: Effects Assessment Summary – Avian Fauna

Effect	Mitigation Measure	Residual Effect Level	Significance of Effect
Construction			
Disruption of bird nests	C25 Vegetation clearing will be used only when necessary and will be limited to hedgerow habitats. C27 Whenever possible, timing of work in close vicinity to woodlots will occur outside the core bird nesting period (in forested habitat, 24 May to 31 July). *Migratory Birds Convention Act* prohibition periods may be required. C28 If clearing must occur within nesting period, a trained biologist should inspect the proposed work area for nesting birds prior to any site clearing.	Minimal	Not significant
Habitat Loss	C25 Vegetation clearing will be used only when necessary and will be limited to hedgerow habitats. C29 Trees with large stick nests will be left undisturbed.	Minimal	Not significant
Operation			
Disruption of bird behaviour	O3 Landowners will be advised to keep habitats in proximity to turbines in active agricultural state to minimize hunting and nesting activities in close proximity. O4 The proposed turbine layout considers potential bird movement between large woodlots or wetland communities.	Low	Not significant
Collisions with turbines and overhead power lines	O5 Single wooden pole structures will ensure that power lines are on same level and minimize the potential for collisions. O6 Pole heights will not extend far above the canopy of adjacent forest communities and will decrease potential for collisions with migrants. O7 Lighting of towers and use of strobe lighting will be kept to minimum allowable levels. Discussions with Transport Canada will be held to encourage the use of white flashing lights at night.	Low	Not significant
Decommissioning			
Disruption of bird nests	Same as C25, C27, and C28	Minimal	Not significant

5.6.3 Follow-up and Monitoring

5.6.3.1 Construction Phase Monitoring

If work must occur within the nesting period, prior to any site clearing a trained biologist should inspect the proposed work area for nesting birds, identify and delineate work zones prior to undertaking work, and regularly inspect the extent of the work to ensure that the spatial extent of the work is minimized.

5.6.3.2 Operation Phase

As a result of the presence of birds that perform aerial flight displays in the proposed area, the proposed Project has been deemed a 'High' sensitivity site based on the February 2007 *Wind Turbines and Birds* guidance document (Environment Canada 2007). Because of the number of turbines proposed, the overall level of concern for this project will be Category 4. As a result, at least 2 years of post-construction monitoring is recommended by Environment Canada, consisting of mortality monitoring by means of systematic carcass searches. In addition to mortality monitoring, scavenger surveys are also recommended, and all mortality searchers should be tested for searcher efficiency.

A detailed carcass search protocol is recommended to be developed in conjunction with the appropriate agencies that will address the major issues including number of turbines to be searched, search frequency, and timing of the searches. To accurately address potential risks and effects on bird populations, the carcass searches should focus on the periods when birds are known to be most active or concentrated within the area. Post-construction mortality monitoring for birds should focus primarily on spring and fall migration periods, but should initially occur during all four seasons with varying efforts during each season to address other concerns including winter staging and breeding bird periods. Overall monitoring period and search effort should be readdressed and discussed with appropriate agencies following the completion of the first year of post-construction monitoring. Mortality monitoring of birds should be conducted in conjunction with similar activities for bats.

Because Manitoba has no existing guidelines, the monitoring protocol will be developed in conjunction with Environment Canada, Manitoba Conservation, and other federal regulatory agencies such as NRCan. This will ensure that actions are carried out as expected, and for the necessary duration. The monitoring plan should also include a description of the post-construction monitoring work to be done, the data that will be collected, and what information will be made available to the public.

5.6.3.3 Decommissioning Phase

If work must occur within the nesting period, prior to any site clearing a trained biologist should inspect the proposed work area for nesting birds, identify and delineate work zones prior to undertaking work, and regularly inspect the extent of the work to ensure that the spatial extent of the work is minimized.

5.7 Bats

5.7.1 Introduction and Scoping

In December 2006, the Ontario Ministry of Natural Resources released a document with information on bat ecology, as well as a literature review of impacts (OMNR, 2006). Mortality of bat species has been reported at some wind power facilities in North America, as well as in Europe. A technical workshop entitled "Bats and Wind Power Generation", conducted in February 2004, identified that bat/turbine interactions are resulting in mortality at some locations. The specifics of these interactions in terms of number, context, etc. are little known and further research was recommended (Energetic Inc., 2004).

In some cases, bat fatalities have far outnumbered bird fatalities, and so the importance of researching bats at wind farms has become extremely important (Arnett, 2005, Arnett et al., 2004). The number of bats killed in the eastern U.S. at wind energy facilities installed along forested ridgetops has ranged from 15.3 to 41.1 bats per MW of installed capacity per year (Kunz *et al.* 2007). Bat fatalities reported from other regions of the western and mid-western U.S. have been lower, ranging from 0.8 to 8.6 bats per MW per year, although many of these studies were designed only to assess bird fatalities (Anderson *et al.* 1999). A carcasses search conducted during two years (2006 and 2007) in a wind farm in Ontario reported that 4.5 to 5.5 bats per turbine per year have been hit by turbine blades (James, 2007). Bat Conservation International (2004) produced a summary of findings with respect to bats and wind energy. These findings were compiled from a review of existing studies and field observations, and include:

- Bat fatalities at wind turbines occur world-wide in various habitats.
- Bat fatality at wind turbines is currently under-studied.
- Bat fatalities have occurred at all U.S. wind facilities with estimated (conservative) mortalities between 2-50 bats/turbine/year (whereas bird fatalities generally number less than 1 bird/turbine/year).
- Searcher efficiency and carcass removal by scavengers is highly variable.
- Bat mortality appears to be highest in or near forests, especially along ridge tops, and lowest in open grassland or farmland away from forests.
- Hoary, Red, and Silver-haired Bats (migratory) are killed most frequently.
- Bats rarely strike meteorological towers or non-operating wind turbines.
- FAA (Federal Aviation Administration) lighting does not appear to have an effect on mortality.
- Peaks in bird and bat fatalities are largely non-overlapping, with bats preceding birds in fall migration.
- Red Bats are among those most frequently killed by turbines and appear to have been already reduced sharply from historical numbers.
- Bats are long-lived with low reproduction rates (unlike most species of birds) and appear to be especially vulnerable to turbine-related mortality.

A number of theories have been tabled to explain cases where bat mortality has been recorded at wind farms (Kunz, 2004). In most cases high mortality seems to be associated with:

- Proximity to mines or caves that are used by high concentrations of roosting bats. In these cases, the sheer numbers of bats moving through an area may result in higher mortality (Keeley et al., 1999).
- High use of areas by migrant bat species (Keeley et al., 1999). During migration, these species typically fly higher and may not use echolocation.

Other hypotheses – including attraction to warmth, lights, and insects – have not been found to adequately explain incidents of mortality.

At the Avian Interactions with Utility Structures Conference in Charleston, South Carolina, a panel presentation led by Keeley et al. (1999) identified pre-construction spring, summer and fall surveys using bat detectors as helpful in avoiding unnecessary mortality. They further recommended a literature review to determine local species and known roost areas.

The assessment of environmental effects on bats considered the three project phases: (1) site preparation and construction, (2) operation, and (3) decommissioning. The specific potential effects on bats include:

- Habitat Loss;
- Bat collisions with operational turbines.

5.7.2 Effects Assessment

5.7.2.1 Habitat Loss

Proposed layouts of turbines, access roads, and transmission lines suggest that up to 31 existing deciduous hedgerows may be affected during the construction phase of this project. Proposed access roads will cross hedgerows in three locations, and an additional 28 crossings may occur as a result of proposed transmission lines. Each hedgerow crossing will result in an anticipated effect on between 0-5 trees. These trees are unlikely to provide preferred roosting habitat for individual bats, and are not anticipated to support large populations of local bat species. Significant bat habitat, including snags, will not be affected during the construction phase of this Project. The resulting habitat loss for bat populations is expected to be minimal and not significant.

5.7.2.2 Bat Collisions with Operational Turbines

Significant habitat and concentration factors are contributors to increased bat activity. Significant bat habitat includes abandoned caves and mines, buildings, snags, and riparian and aquatic habitat. Background review was conducted, and vegetation surveys were undertaken to evaluate the presence and extent of these habitat types within the Study Area. No significant bat habitat exists in the vicinity of the Study Area. In addition to significant habitat, landscape features known to concentrate bat activity were also examined in the vicinity of the Study Area. These features include forested ridges and shorelines of major bodies of water. The shoreline of the Red River is approximately 1.1 km from the nearest proposed turbine. This is a potential concentrating factor for local and migratory bat populations. Buildings, snags, and limited riparian and aquatic habitat are found within the Study Area, and are expected to provide preferred habitat for local bat populations. These habitat types are found in the Project Area but will not be directly affected by the Project's infrastructure and equipment.

Wind Turbines and Bats (OMNR 2006) stated that artificially lit structures attract high concentrations of insect activity, and therefore suggested that foraging bats may also be attracted to these areas. As a result, bats may be more susceptible to collisions with lit turbines. Other studies have examined this correlation and have observed no significant relationship between lit turbines and bat fatalities (Arnet et al. 2005; Johnson 2004). In attempts to ensure minimal effects on local bat populations, the number of lit turbines should be kept to a minimum.

During the operation phase, a maximum of 200 turbines will be commissioned. Acoustic bat monitoring conducted during the spring, summer and fall of 2007 revealed low passage rates throughout the monitoring period, even during typical peak periods of summer swarming and bat migration. The residual effect level of concern is therefore considered to be low and not significant.

At the end of the Project, all turbines should be properly dismantled and removed from the Project Area. This will prevent additional collisions with non-operational turbines.

Table 5-8: Effects Assessment Summary – Bats

Effect	Mitigation Measure	Residual Effect Level	Significance of Effect
Construction			
Habitat Loss	C25 Vegetation clearing will be used only when necessary and will be limited to hedgerow habitats. C30 Significant bat habitat, including snags, will be avoided during clearing of any vegetation.	Minimal	Not significant
Operation			
Bat Collisions with Operational Turbines	O7 Lighting of towers and use of strobe lighting will be kept to minimum allowable levels. Discussions with Transport Canada will be held to encourage the use of white flashing lights at night.	Low	Not Significant
Decommissioning			
None	-		

5.7.3 Follow-up and Monitoring

5.7.3.1 Construction Phase Monitoring

No additional monitoring during the construction phase is recommended.

5.7.3.2 Operation Phase

Currently no pre- or post-construction bat monitoring guidelines exist for the Province of Manitoba. Pre-construction bat monitoring was based on guidance documents prepared for the Provinces of Ontario (OMNR 2007a) and Alberta (AFWD 2005). Based on the Ontario bat guidance document (OMNR 2007), this Study Area would be classified as a medium sensitivity area for bat populations. As a result, appropriate guidance documents suggest that at least 2 years of post-construction monitoring from May through September should be conducted. Post-construction monitoring consists of mortality monitoring by means of systematic carcass searches, and could be conducted in conjunction with avian post-construction monitoring. In addition to mortality monitoring, scavenger surveys are also recommended, and all mortality searchers should be tested for searcher efficiency.

A detailed carcass search protocol is recommended to be developed in conjunction with the appropriate agencies that will address the major issues including number of turbines to be searched, search frequency, and timing of the searches. To accurately address bat collisions, the periods when bats are known to be most active and at risk will be the focus of the carcass searches. These time periods include spring migration, summer swarming, and fall migration, and represent the periods of May and mid-July through mid-October. A slightly less active period of summer foraging occurs from early June through mid-July that should also be addressed in the carcass search protocol.

The monitoring protocol is recommended to follow general CWS, OMNR, and AFWD guidelines and should be developed in conjunction with Environment Canada, Manitoba Conservation, and other provincial or federal regulatory agencies such as NRCan. This will ensure that actions are carried out as expected, and for the necessary duration. The monitoring plan should also include a description of the post-construction monitoring work to be done, the data that will be collected, and what information will be made available to the public.

5.7.3.3 Decommissioning Phase

No follow-up monitoring specific to bat populations will be required during the decommissioning phase of this Project.

5.8 Terrestrial Fauna

5.8.1 Introduction and Scoping

Typically, the largest anticipated effects on local populations of terrestrial mammals are habitat loss and direct mortality during the construction phase of development. However, given the agriculturally dominated landscape of the area and the lack of natural habitat in proximity to the proposed turbines, access roads and transmission lines, this direct effect is not anticipated.

Small mammals will initially be most affected by the construction of access roads and turbines. The Bureau of Land Management and the U.S. Department of the Interior (BLM and DOI, 2005) indicate that machinery used during access road and turbine site clearing can result in mortality of less mobile mammals. The extent of the effects caused by construction-related activities is directly related to a number of factors; species abundance, wind farm size, and construction timing all contribute to the overall effects on mammal populations (BLM and DOI, 2005). Construction during reproductive periods of any ground-nesting mammals should be avoided if possible, due to increased susceptibility to both adults and offspring during these periods. Substantial populations of these species are not known to inhabit the Project Study Area.

No significant terrestrial habitat linkages are found within the Study Area, and therefore no impacts to wildlife movement are anticipated.

No significant mammal species were observed within the Study Area. The Plains Pocket Gopher (*Geomys bursarius*) has a range map that overlaps with the Project Area and is considered uncommon in Manitoba. Although pocket gopher mounds were observed within the Study Area, they are likely due to the presence of Northern Pocket Gophers (*Thomomys talpoides*), a very common species in southern Manitoba. A study by Erickson et al. (2003) indicates that excavation processes undertaken during construction may cause direct mortality to some burrow-dwelling mammals. This is a short-term and localized effect on populations, and local populations are expected to rebound upon completion of construction. Mammals may also encounter invasive vegetation, increased dust generation, high noise levels, and possible exposure to contaminants during construction (BLM and DOI, 2005). All of these are expected to cause short-term disturbances in foraging, reproduction, or other behavioural attributes, with the exception of invasive vegetation. Invasive vegetation in this agricultural landscape is not considered to be an issue since the proposed work areas are already actively tilled, and are suitable distances from naturally occurring vegetation communities.

Very few studies have focused directly on potential threats and impacts of wind energy projects on reptiles and amphibians. Typically, the majority of the threats will occur during construction and decommissioning of the Project, as for any other industrial-type development. Many of the potential threats to local populations will be localized disturbances, and will be short-lived, ending upon completion of the construction phase. The major threat to herpetofauna is habitat disturbance, particularly fragmentation of adequate habitat by access roads and potential spur roads. However, since the Project will be located in actively tilled farm fields and not result in loss of any natural habitats, this impact is not anticipated. Hedgerow habitats are also important for many herpetofauna near the Study Area. These habitats have been mapped and generally classified. A total of 31 hedgerows may be affected during the construction phase of this project. No proposed clearing will occur in natural habitats, further limiting direct impacts to local herpetofaunal populations. Impacts to amphibian movements between ponds and other habitats (for breeding, etc.) will not occur. The Northern Leopard Frog (*Rana pipiens*) was previously widespread in Manitoba (Preston 1984); however, the western populations of this species are now designated as Special Concern by COSEWIC. The Northern Leopard Frog is not ranked or protected provincially. This species was identified in a drainage ditch near the large ponds associated with the Miller Environmental property. This observation was made more than 200 m from the nearest proposed turbine location. Based on the distance of the nearest proposed turbine and proposed access road, there will be no significant impacts to this location.

Other potential threats during the construction phase, as discussed by BLM and DOI (2005), include direct injury, erosion and runoff into streams and ponds, dust generation, exposure to contaminants, and invasive vegetation. Best management practices are available in order to reduce these types of impacts. This affect on local populations, as described by Erickson et al. (2003), is directly related to the species' specific abundance. Timing of the major construction period will also play an important role in the number and species affected by direct injury. Avoidance of spring construction will aid in reducing the number of amphibian and reptile casualties during the construction phase. Populations of these species within areas proposed for development are not expected to be high, and spring construction is therefore not anticipated to have significant effects on local populations of reptiles and amphibians.

Erosion and runoff from construction sites may have negative impacts on local populations of amphibians that rely heavily on water supply. Silt build-up in local streams can affect growth, reproduction, and overall survival of amphibian populations (BLM and DOI, 2005). These effects would however be localized at streams and ponds adjacent to a wind energy project. There is very little creek and open aquatic habitat present within the Study Area, however, agricultural roadside drains are abundant. Other threats, including dust generation, invasive vegetation, and exposure to contaminants present a lesser threat than those previously discussed, though are still important considerations during the construction process. Exposure to contaminants and chemicals is not anticipated; however, fuel spills or other chemicals accidentally coming into contact with the environment may have strong effects on amphibians due to the permeability of their skin. During this Project, no excessive amounts of fuel are expected, reducing the likeliness of a detrimental spill.

Upon completion of the construction phase, many of these threats will be eliminated relatively quickly. The lands will be retuned to active agricultural use during the operation phase and after decommissioning.

The assessment of environmental effects on terrestrial fauna considered the three project phases: (1) site preparation and construction, (2) operation, and (3) decommissioning. All hedgerows within the Study Area have been mapped and briefly described, as they provide suitable habitat for many reptile species. Up to 31 hedgerows will be crossed by proposed access roads or transmission lines, but will be limited in the number of trees removed, if any. Since no impacts to terrestrial wildlife movement will occur, the potential effects are limited to:

- Noise impacts on wildlife;
- Wildlife mortality due to traffic;
- Habitat loss.

5.8.2 Effects Assessment

5.8.2.1 Noise Impacts on Wildlife

Some noise will be produced during construction phase activities such as site prospecting, transport, construction of access roads, preparation of concrete foundations, and installation of the electrical network and turbines. It is expected that wildlife will avoid the areas under construction.

Turbines also produce varying levels of noise when operational, in the order of 60 dBA at the base of the turbine to 30-45 dBA a few hundred metres away. However, wildlife typically acclimates to noise levels such as those which are anticipated, as indicated by Strickland et al. (1998) and the Institute of Wildlife Research (2004) which have investigated large mammal behaviour in and around wind farms in Europe and North America. Proposed turbines will be no closer than 300 m to natural wooded areas, or other natural habitats, further limiting the potential for noise impacts on wildlife populations.

For the most part, the impacts will be of short duration during construction and very local in proximity to the activity; the residual effect level of concern is therefore considered to be minimal and not significant.

5.8.2.2 Wildlife Mortality due to Traffic

Traffic is a consideration during project activities that require site access such as site prospecting, transport, construction of access roads, preparation of concrete foundations, and installation of electrical network and turbines, as well as decommissioning. Traffic will be restricted in terms of volume and daylight access and will be very low. The residual effect level of concern is therefore considered to be minimal and not significant.

5.8.2.3 Habitat Loss

Many small animals, including reptiles, amphibians, and mammals, are known to utilize hedgerow habitats. Proposed layouts indicated that 31 existing hedgerows will be crossed by access roads or transmission lines. These hedgerows are dominated by deciduous trees, and likely provide little habitat, but may represent a narrow movement corridor for small animals. Effects to these hedgerows are anticipated to be extremely limited and localized in nature, and may affect between 0-5 trees at each of the proposed crossings. As a result of the localized nature of these proposed effects, the resulting impacts to local small animal populations is expected to be minimal and not significant.

Table 5-9: Effects Assessment Summary – Terrestrial Fauna

Effect	Mitigation Measure	Residual Effect Level	Significance of Effect
Construction			
Noise impacts on wildlife	C31 Construction activities will mostly occur during daylight hours and will be limited in terms of duration.	Minimal	Not significant
Wildlife mortality due to traffic	C2 Speed of traffic will be reduced on unpaved roads. C31 Construction activities will mostly occur during daylight hours and will be limited in terms of duration. C32 Where required, sight-line considerations will be used to maximize reaction time for vehicle drivers and wildlife.	Minimal	Not significant
Habitat Loss	C25 Vegetation clearing will be used only when necessary and will be limited to hedgerow habitats.	Minimal	Not significant
Operation			
Noise impacts on wildlife	-	Minimal	Not significant
Decommissioning			
Noise impacts on wildlife	Same as C31	Minimal	Not significant
Wildlife mortality due to traffic	Same as C2, C31, C32	Minimal	Not significant

5.8.3 Follow-up and Monitoring

No additional monitoring of wildlife or associated habitats is recommended for populations of terrestrial fauna.

5.9 Economic and Community Setting

5.9.1 Introduction and Scoping

The construction and operation of the Project in the RMs of Montcalm and Rhineland will have effects on their local economy and community setting.

The potential effects are listed here and are further discussed below:

- Job creation and training;
- Economic returns and losses;
- Increased demand for housing.

5.9.2 Effects Assessment

5.9.2.1 Job Creation and Training

The Project will create new jobs in the area, as well as provide an opportunity for specialized training.

Job creation estimates vary. A review by La Capra Associates (2005) and estimates from PESCA Environnement and Helimax (2005) indicate that large-scale wind energy projects generate approximately 0.5 to 1 job per MW during the construction phase. About half of these jobs are associated with clearing and road construction, while the other half is associated with transportation and installation of turbines and other components. Under these assumptions, the Project will generate 200 to 300 jobs during the construction phase. During the operation phase, it is estimated that 15 specialized operation and maintenance (O&M) jobs will be created.

In order to maximize benefits to local communities, local populations including members of the Roseau River First Nation will be given priority in job opportunities. The residual effect is considered medium and significantly positive during the construction and operation phases, and low and not significant during the decommissioning phase.

5.9.2.2 Economic Returns and Losses

The increased number of workers and increased income will increase spending in local communities, namely for goods, services, and housing. Landowners of the lots where wind turbines or other project components will be sited will receive monetary compensation annually throughout the service life of the Project. St. Joseph Wind Farm has also committed to an annual donation to the St. Joseph Museum.

Other large-scale wind projects in Canada that have been commissioned in agricultural or rural areas (e.g. St. Leon in Manitoba, and several projects in Ontario, Alberta and Quebec) have generally experienced an increase in tourism-related activities.

Blake, Matlock and Marshal Ltd. (2006) conducted an independent review of real estate values in the Township of Melancthon, the Township of East Luther Grand Valley and the County of Dufferin in Ontario. The intention of this effort was to determine if recent wind energy development in the Melancthon area has had any effect on property values when compared to East Luther Grand Valley where wind farm projects have not been implemented and to calculate average prices throughout Dufferin County.

The study concluded that the Township of Melancthon has demonstrated consistent patterns of growth on most accounts despite being targeted for wind farm development and similar growth to Dufferin County as a whole which included communities where no wind projects had been commissioned. The Township of Melancthon has further shown superior growth to the Township of East Luther Grand Valley which is devoid of wind farm development and which demonstrated inferior growth to Dufferin County statistics. The authors state that “the economics and environmental circumstances surrounding large scale wind energy initiative has not seen to have diminished property value but rather to have arguably nourished property value by its presence” (Blake, Matlock and Marshal Ltd., 2006).

Another assessment of effects on property values was performed by Polletti and Associates Inc. (2007). Its approach consisted of considering the compatibility of the wind farm land use with the established and historic land uses, and its effect on the use, marketability and the value of other property in the vicinity. Its general procedure consisted of a preliminary on-site inspection of the subject property and the surrounding area, followed by a review of various documents such as maps, ownership plats and data on real estate transfer in proximity; this led to the analysis of property transactions in the surrounding area. This report successfully determined that the proposed White Oak Wind Energy Center in McLean and Woodford Counties in the state of Illinois was located so as to minimize any effect on property values (Polletti and Associates Inc., 2007).

A third study conducted by Renewable Energy Policy Project (2003) assessed the effects of wind farms on property values. Ten wind farms across the United States were analyzed through three different cases. Statistical evidence did not support the contention that property values within the “View Shed of Wind Projects” suffer or perform poorer than in the “Comparable Region.”

Based on these studies and on the local agricultural context, the potential adverse effect on property values is considered not significant. Generally, no adverse economic effects are anticipated with respect to the construction, operation or decommissioning phases. The residual economic effects are considered medium and significantly positive during the construction and operation phases, and low and not significant during the decommissioning phase.

5.9.2.3 Increased Demand for Housing

During major construction projects, there is always a chance that an influx of temporary workers requiring overnight accommodations will outstrip the supply of temporary housing. As described above, an estimated 200 to 300 workers will be involved during the construction period, which will last 12 to 18 months.

However, most of the construction workforce is expected to come either from the immediate region or from the Winnipeg area. Due to the relatively short length of the construction period for any individual task, most construction workers are expected to commute daily. Therefore, these workers would not require overnight lodging.

Given the small-scale nature of the activities during the operation phase, it is not expected that long-term jobs during operation and maintenance will increase demand for additional local housing.

The residual effect of the Project on increased demand for housing is considered minimal and not significant.

Table 5-10: Effects Assessment Summary – Economic and Community Setting

Effect	Mitigation Measure	Residual Effect Level	Significance of Effect
Construction			
Job creation and training	C33 A program for training local populations and First Nations will be implemented in order to provide job opportunities to local people.	Medium (Positive)	Significant (Positive)
Economic returns and losses	C34 Affected landowners will be compensated.	Medium (Positive)	Significant (Positive)
Increased demand for housing	None	Minimal	Not significant
Operation			
Job creation and training	O8 A program for training and job opportunities will be implemented for local populations and First Nations.	Medium (Positive)	Significant (Positive)
Economic returns and losses	O9 A compensation program will be implemented for affected landowners. O10 An annual donation will be given to St. Joseph Museum.	Medium (Positive)	Significant (Positive)
Decommissioning			
Job creation and training	Same as **Error! Reference source not found.**	Low (Positive)	Not significant (Positive)
Economic returns and losses	Same as C34	Low (Positive)	Not significant (Positive)
Increased demand for housing	None	Minimal	Not significant

5.9.3 Follow-up and Monitoring

Considering the minimal residual effects and the positive economic and social benefits that the Project is expected to have on the local economic and community setting, no follow-up or monitoring is considered necessary.

5.10 Public Services and Infrastructures

5.10.1 Introduction and Scoping

The construction and operation of the Project in the RMs of Montcalm and Rhineland will have effects on their local public services and infrastructure.

The potential effects are listed here and are further discussed below:

- Increased traffic on main roads;
- Damage to roads;
- Increased demand for health services;
- Interference to communication systems.

5.10.2 Effects Assessment

5.10.2.1 Increased Traffic

Construction activities associated with the Project will increase traffic volumes on roadways surrounding the Project Area. Traffic will mainly be associated with increased heavy load convoys and concrete trucks. As per the construction schedule, this increased volume will be stretched over two years.

Large convoys could slow traffic on Highway 75 and nearby provincial roads. Local and regional authorities will be informed of the transportation plan to avoid any unexpected circulation problems; this plan will include the complete construction schedule, convoy schedule and density, types of vehicles, etc. Required transportation permits will be obtained from Manitoba Infrastructure and Transportation. In an effort to further mitigate potential disturbances due to increased traffic on roads, routes outlined in the transportation plan for transportation of materials and turbine components will avoid, whenever possible, school bussing routes and/or schedules.

Considering the proposed mitigation measures, the residual effect on traffic is of low concern during construction and decommissioning, and minimal during the operation phase. For all three phases, the residual effect is considered not significant.

5.10.2.2 Damage to Roads

Municipal road upgrades will potentially be required on unpaved segments that lead to the Project Area. These roads and others used for the Project will be upgraded to comply with standards for wind energy project construction. After construction, all municipal roads used for the Project will be inspected and repaired if damages were incurred. Given these measures, the residual effect on roads is minimal and is considered not significant.

5.10.2.3 Increased Demand for Public Health Services

Demand for emergency medical services could increase slightly due to construction accidents that might occur at the Project site or the vicinities. Project construction workers will be exposed to hazards caused by equipment failure, severe weather, or human oversight that could require the services of local emergency response units to provide initial treatment and transportation to a local medical facility, as well as the services of emergency rooms in the receiving facility.

With adequate safety measures in place, it is expected that the Project's construction will generate few serious injury accidents requiring emergency medical response, and that local services can adequately respond. The residual effect on public health services is minimal and considered not significant.

5.10.2.4 Interference to Communication Systems

As mentioned in Section 3.11.6, in accordance with the RABC/CanWEA Guidelines (2007) and in light of the consultation zones recommended therein, Helimax has conducted an inventory and an impact assessment of radiocommunication, radar and seismoacoustic systems present in the vicinity of the Project. Public databases were queried and notices to relevant agencies (potentially detaining information on protected systems) were sent to complete the inventory. The complete report is presented in Appendix B.

Generally speaking, no effects are anticipated to most of the communication systems, radars and seismoacoustic systems, given the Project's location and design.

Interference might affect signal quality at Environment Canada earth station in the meteorological satellite service. The impact will be evaluated with the system owner.

Although no turbine is located near an analogue or digital television emitter, interference might affect signal quality at certain receptor locations. Approximately 2180 buildings with potential presence of TV receptors are located within the recommended consultation zone defined around the Project.

One registered satellite system (earth station in the meteorological satellite service) owned by Environment Canada is overlapping with two turbine positions (WTGs #144 and 145). The nearest is located 552 m away from the system.

WTGs #40, 41, 45, 66, 98, 99, 100, 148 and 184 are located within the 1-km radius consultation zone around land mobile and fixed stations. Noting that the nearest turbine is located 305 m away from the system, no effect to these systems is anticipated.

Two cellular base stations are located within the Project Area. Though no turbine is located within the 1-km consultation zone of these two stations, interference might affect signal quality at certain receptor locations. The reception would be only affected when the receiver is located a few metres away from a turbine, thus the impact is considered minimal.

Table 5-11: Effects Assessment Summary – Public Services and Infrastructure

Effect	Mitigation Measure	Residual Effect Level	Significance of Effect
Construction			
Increased traffic on roads	C35 Construction and traffic management plan: the Proponent will inform local and regional authorities of its transportation plan to avoid any unexpected circulation problems; this plan will include the construction schedule, convoy schedule and density, types of vehicles, etc.	Low	Not significant
Damage to roads	C36 Segments used during construction in the vicinity of the Project Area will be upgraded and improved.	Minimal	Not significant
Operation			
Increased traffic on main roads	None	Minimal	Not significant
Interference to communication systems	None	None	None
Decommissioning			
Increased traffic on main roads	Same as C35	Low	Not significant
Accidents and Malfunctions			
Increased demand for public health services	A&M8 Accidents and Malfunctions Plan: Industry-standard safety measures to reduce the risk of work-related accidents will be implemented.	Minimal	Not significant

5.10.3 Follow-up and Monitoring

Considering the minimal residual effects that the Project is expected to have on the local public services and infrastructure, no follow-up or monitoring is considered necessary.

5.11 Land Use

5.11.1 Introduction and Scoping

As mentioned in Section 3.12, activities in the Project Area and in the vicinity are limited mostly to agricultural practices by the landowners and to rural activities by permanent residents. There are a few wooded lots around the site but none will be significantly impacted by any of the components of the Project.

The effects of the Project on land use are summarized as follows and are described in the paragraphs below:

- Reduction of land for agricultural purposes;
- Increased truck traffic on private access roads.

5.11.2 Effects Assessment

5.11.2.1 Reduction of Land for Agricultural Purposes

Sited on privately-owned agricultural land, the towers, access roads, and substation will occupy a measurable area of land. For the life duration of the Project, these surfaces, estimated at 186 ha or 0.9% of the Project Area, will not be used for agricultural practices.

In Section 2.3.4, a comparative summary of the footprints associated with the Project construction and operation phases was tabulated. The magnitude of the total footprint during operation is almost half the size of the total temporary footprint of the construction phase. For the area that will remain occupied by components of the Project throughout its expected service life, the following mitigation measures are applied:

- Landowners shall be compensated as per the signed agreements.
- After construction and after decommissioning, occupied land shall be returned to its initial state. After decommissioning, the top section of the tower foundations will be removed to enable total resumption of agricultural operations through the site reclamation strategy.
- Respect as much as possible the proposed schedule such that construction-related activities take place during periods of low agricultural activity, as planned.

Considering the proposed mitigation measures, the residual effect is considered low and therefore not significant.

5.11.2.2 Increased Traffic on Private Access Roads

During the construction and operation phases, there will be increased traffic on the private access roads leading to the wind turbines. In addition to the convoys that will bring turbine sections to each turbine location for assembly and installation, there will be trucks using the access roads. During commissioning and operation, pick-up trucks – most likely one or two at a time – will use the access roads. Although the commissioning phase spans a shorter period, truck traffic will be more frequent than during operation. During the operation phase, each wind turbine will have to be serviced every six months for mandatory inspection of electrical wiring, mechanical adjustments and tests, oil and filter change, and greasing and alignment of the generator. All pick-up trucks will be parked and turned off on the access roads at the base of the wind turbine as close as possible to the tower. Regular maintenance works will most likely last an entire work day per turbine.

Potential effects will be minimized by applying the following mitigation measures:

- Respecting, as much as possible, operation and maintenance schedule of servicing no more than every three months;

- Raising awareness of all workers to remain within the Project's footprint boundaries. Respecting boundaries and crops, as much as possible, of private agricultural land;
- Whenever possible and when preferred by landowners, securing existing gates at the entrance of access roads with different locks.

Considering the proposed mitigation measures, the residual effect is considered minimal and therefore not significant.

Table 5-12: Effects Assessment Summary – Land Use

Effect	Mitigation Measure	Residual Effect Level	Significance of Effect
Construction			
Reduction of land for agricultural purposes	C34 Affected landowners will be compensated. C37 After construction and decommissioning, temporary work areas will be returned to their initial state through the site reclamation strategy. C38 The proposed schedule will be respected as much as possible such that project-related activities take place during periods of low agricultural activity.	Minimal	Not significant
Increased truck traffic on private access roads	C38 The proposed schedule will be respected as much as possible such that project-related activities take place during periods of low agricultural activity. C39 Workers will remain, as much as possible, within the delimited Project footprint. C40 Whenever possible and when preferred by landowners, existing gates at the entrance of access roads will be secured with different locks.	Minimal	Not significant
Operation			
Reduction of land for agricultural purposes Increased truck traffic on access roads	C38 The proposed schedule will be respected as much as possible such that project-related activities take place during periods of low agricultural activity. C39 Workers will remain, as much as possible, within the delimited Project footprint.	Minimal	Not significant
Decommissioning			
Increased truck traffic on private access roads	Same as C39 and C40	Minimal	Not significant

5.11.3 Follow-up and Monitoring

Considering the minimal residual effects that the Project is expected to have on this component, no follow-up or monitoring is considered necessary.

5.12 Archaeology and Heritage Resources

5.12.1 Introduction and Scoping

At the early stage of the Project development, Helimax consulted the Historic Resources Branch of the Minister of Culture, Heritage and Tourism regarding potential archaeological and cultural heritage resources in the Project Area. The Historic Resources Branch considered the potential to impact significant heritage resources as moderate, and required that an archaeological consultant be contracted to identify and assess any heritage resources that may be negatively impacted by construction (Pers. comm., Hill, 2006). The results from the desktop HRIA are presented here below. Baseline information for this component is presented in Section 3.13.

Soil disturbance due to construction activities such as staging area, foundation, access roads, buried electrical cabling present the risk of archaeological and cultural heritage sites being disturbed. The effects of the Project on archaeological and heritage resources are summarized as follows and are described in the paragraphs below:

- Loss of archaeological and cultural heritage resources.

5.12.2 Effects Assessment

5.12.2.1 Loss of Archaeological and Cultural Heritage Resources

As recommended by the archaeological consultant, an acceptable setback of 300 m from known heritage sites was used to design the turbine layout in order to minimize any impacts to known sites.

Because the physical location of most archaeological sites is below ground surface and because minimal archaeological field survey has occurred in this area, it is difficult to determine which areas may contain heritage resources and which may not. However, given the many years of agricultural activity throughout this area, there is probably less risk of intact sites being disturbed by the construction of a wind farm.

Potential effects will be minimized by applying the following mitigation measures:

- An archaeological field survey will be considered prior to construction of WTG structures located less than 1 km from a known archaeological and/or cultural heritage site.
- Particular caution will be taken at WTG sites close to the settlement of St. Joseph since several Centennial Farms are located in the vicinity. Here as with other known heritage sites, a minimum setback of 300 m has been used. It should be noted that heritage sites close to residences are all located at distances greater than 500 m due to the minimum setback from residences and noise issues.
- Further caution shall be taken with respect to the potential presence of both pre-European contact and historic burials and abandoned cemeteries. Should human remains be found during any component of the Project, all work at that location will halt and the Historic Resources Branch will be contacted immediately, as per the Province of Manitoba Policy for the Exhumation of Found Human Remains (1987).
- As a cautionary measure, workers will be made aware of the potential presence of heritage resources in sensitive areas. If evidence of heritage resources is found, a field archaeological survey will be conducted.

Considering general avoidance of the known sites and provided that the above measures are taken by the Proponent, residual effects to archaeological resources are considered low and not significant.

Table 5-13: Effects Assessment Summary – Archaeological and Heritage Resources

Effect	Mitigation Measure	Level of Concern	Significance of Effect
Construction			
Loss of Archaeological and Cultural Heritage Resources	C41 An archaeological field survey will be considered prior to construction of WTG structures located less than 1 km from a known archaeological and/or cultural heritage site. C42 Particular cautions will be taken at WTG sites close to the settlement of St. Joseph. C43 Should human remains be found during any component of the Project, all work at that location will halt and the Historic Resources Branch will be called immediately. C44 As a cautionary measure, workers will be made aware of the potential presence of heritage resources in sensitive areas. If evidence of heritage resources is found, a field archaeological survey will be conducted.	Low	Not significant

5.12.3 Follow-up and Monitoring

Considering the minimal residual effects that the Project is expected to have on this component, no follow-up or monitoring is considered necessary.

5.13 Acoustic Environment

5.13.1 Introduction and Scoping

Activities associated with wind energy projects can increase ambient noise levels, which in turn can constitute a disturbance to wildlife and humans. Noise is common to any medium- or large-scale project during construction, due to the use of heavy machinery and vehicles. During operation, turbines in operation emit noise that originates from the blades (aerodynamic noise) and from the nacelle's internal electrical and mechanical components (mechanical noise). The effect of operating turbines on ambient noise levels and related disturbance is often raised by the public, regulatory agencies and First Nations.

Potential effects to the acoustic environment include:

- Increase in ambient noise levels during construction and decommissioning;
- Increase in ambient noise levels during operation.

5.13.2 Effects Assessment

Increase in Ambient Noise Levels during Construction/Decommissioning

Construction and decommissioning activities will generate noise from the use of heavy machinery and vehicles. The contribution to noise levels is only expected on site – a low population density area – and during a short period of time, i.e. the few months of planned work during the construction/decommissioning periods. Increased truck transport is not expected to significantly increase ambient noise levels on existing roadways, due to the already existing truck traffic on these roads. Increased noise levels will be of medium magnitude on the municipal access roads, but of short duration, intermittent and local. Overall, the effect of construction on ambient noise levels is of low concern and considered not significant.

In order to minimize any effects during construction, the Proponent will limit construction activities to daytime and early evening hours, and will implement a construction and traffic management plan.

Increase in Ambient Noise Levels during Operation

Predicted Noise Levels at Points of Reception

As mentioned earlier, the turbine layout optimization was performed concurrently with the noise impact assessment to ensure that the effect of the operating wind turbines on ambient noise would be minimal and comply with national standards and provincial requirements. Therefore, the resulting turbine layout complies with Manitoba Conservation's most recent requirements for wind energy projects, as stated in December 2007 licences[7] and confirmed through discussions with Manitoba Conservation (Pers. Comm., B. Blunt, March 2008).

The Project Area is considered to be Class 3 (rural) as per Ontario MoE Guidelines. As such, at wind speeds up to 6 m/s the prescribed maximum sound level at points of reception is 40 dBA or the minimum hourly background sound level, whichever is greater. At wind speeds above 6 m/s, the sound level limit is the wind induced background sound level plus a specified adder. For example, at 8 m/s the limit is 45 dBA and at 10 m/s, 51 dBA.

Mapping data and site visits were used to locate "points of reception" (non-participating dwellings, i.e. dwellings located on land where no turbine will be installed), in the vicinity of the Project Area, as well as participating dwellings (not considered as "points of reception" in the guidelines). Point of reception height was also noted:

[7] Recent licences state: "The Project must comply with CanWEA guidelines …." which recommend the use of the Ontario Ministry of Environment (MoE) guidelines.

receptor height was either 1.5 m above ground level (one-storey dwellings) or 4.5 m (two-storey dwellings). Several dwellings are located within 1 km of the turbines, but no closer than 550 m.

The noise analysis was done using the ISO 9613-2 standard for calculating noise propagation. The results, presented in Map 5-1, were then compared to the CanWEA guidelines in order to verify that the permissible sound levels would not be exceeded at any point of reception. This analysis indicates that maximum noise levels at all points of reception are compliant with the guidelines. For instance, at 6 m/s winds, maximum noise levels from the turbines are predicted to be 40 dBA outside of any non-participating dwellings. In areas of higher population density, such as the village of St. Joseph, noise levels are projected to be less than 37 dBA. In other higher population density areas, such as 1.6 km North of St-Joseph or 2.4 km East of Neubergthal, noise levels are projected to be less than 39 dBA. At these levels, ambient sounds – e.g. wind hitting foliage, structures and waterbodies – would exceed the noise emitted by the turbines. For all participating dwellings, the layout was designed so that simulated noise levels (outside) would not exceed 45 dBA, in order to minimize the effect on ambient noise at all dwellings in the Project Area, whether participating or not.

Noise Levels on Site

At the base of the wind turbines, it is estimated that noise levels could reach 60 dBA, the equivalent of a normal conversation 1 m away. While these levels decrease with distance, this implies that turbines could be audible on site when operational. Given that the sites exhibit low population density and that all dwellings are found to be compliant with CanWEA guidelines, the effect is of minimal concern and not significant.

Table 5-14 below summarizes the effects of the Project on the acoustic environment.

Table 5-14: Effects Assessment Summary – Acoustic Environment

Effect	Mitigation Measure	Residual Effect Level	Significance of Effect
Construction and Decommissioning			
Increase in ambient noise levels	C31 Construction activities will mostly occur during daylight hours and will be limited in terms of duration. C45 Nearby residents will be advised of significant truck transportation passing through provincial and municipal roads. C46 All internal combustion engines will be fitted with appropriate muffler systems.	Low	Not significant
Operation			
Increase in ambient noise levels	O11 Compliance with Manitoba Conservation requirements (and CanWEA noise guidelines) was considered as criteria for the Project layout design.	Minimal	Not significant

Note on Infrasound and Vibrations

Infrasound is defined as acoustic waves that are below the human threshold of perception. The human ear can detect frequencies as low as 200 Hz whereas infrasound is found within the range of 0 to 20 Hz. Infrasound is a common occurrence in a natural environment as many natural phenomena, such as waves, create infrasound. Infrasound intensity levels of more than 1000 times greater would be necessary simply to be audible and still 1000 times greater than that to cause the minor and short-lived vestibular reactions (fatigue, headaches, nausea) sometimes observed experimentally. The concern of wind turbine-produced infrasound is therefore unfounded (Chouard, 2006; Afsset, 2008). Bell Acoustics Consulting (2004) also corroborated that there is no evidence to indicate that low-frequency sound or infrasound from current models of wind turbine generators should cause concern to anyone living close to a wind turbine generator or a wind farm.

Propagation of vibrations from wind turbines becomes indiscernible from background seismic noise. Their amplitude is in the order of nanometers and they have frequencies ranging between 1 and 10 Hz. Seismic vibrations from wind turbines can only be detected by seismometers (Styles et al., 2005). Vibrations at this level and in this frequency range are created by all kinds of sources such as traffic and background noise – they are not confined to wind turbines. There is no scientific evidence to suggest that infrasound produced by wind turbines has an impact on human health (BWEA, 2005).

5.13.3 Follow-up and Monitoring

Considering the minimal residual effects that the Project is expected to have on this component, no follow-up or monitoring is considered necessary.

5.14 Landscape

5.14.1 Introduction and Scoping

The visual impact of wind energy projects is almost systematically raised as an issue, particularly in areas valued by the local population for their natural, pristine landscapes and for tourism. However, public opinion on the aesthetics of wind turbines is divided: some see them as beautiful structures while others feel that they disrupt natural landscapes. The location of turbines, the size of the Project and the surrounding visual setting are key elements that have an impact on the significance of the visual effect.

The effect of the Project on the quality of landscapes will be assessed in this section. The effects on landscapes will be assessed for the operation phase only, as this is when turbines will be visible and will potentially alter the visual landscape.

5.14.2 Effects Assessment

5.14.2.1 Methodology

The assessment of visual landscape quality is necessarily subjective. There are methodologies in place that have been developed in the United States and adapted to different contexts and to different infrastructures. These methods allow the systematic evaluation of landscape as a resource, and hence, an evaluation of the effect of specific project activities on visual landscapes (U.S. Bureau of Land Management 1986a, b). The method developed by Helimax is derived from these methods and has been applied to a number of projects in Canada.

This visual analysis method involves a two-phase approach consisting of:

- A Sensitivity Analysis of the existing landscape, based on three factors:
  - Absorption Capacity (density and height of vegetation, topography);
  - Insertion Capacity (diversity of land uses);
  - Acknowledged Values;
- A Contrast Perceptibility Analysis of the structures in the landscape, based on two factors:
  - Visual Exposure Degree of the WTGs (proportions of the viewshed occupied by turbines, contrast of the turbine's relative height with the foreground, middleground and background);
  - Observers' characteristics (mobile, permanent, temporary, tourist).

5.14.2.2 Sensitivity Analysis

In the Project Area, the landscape has a medium Absorption Capacity due to the density of tree rows, their proximity to roads and their heights.

The Insertion Capacity is also considered as medium because of the diversity and high visibility of human presence (agricultural land uses, transmission lines and transportation infrastructures, built environment).

Most landscapes of the Project Area are neither renowned nor protected. Therefore, the general Value of most landscapes can be considered as low, with the exceptions of the village townscapes and the landscapes seen from Highway 75, where the value can be considered as medium, and the TransCanada Trail landscapes and the Neubergthal Mennonites Street Village landscapes, where the Value can be considered as high with respect to their national recognition.

The results of the Sensitivity Analysis indicate that almost all of the Project Area has low sensitivity, except for the Neubergthal and the TransCanada Trail landscapes. In these cases, the sensitivity is considered as medium.

5.14.2.3 Contrast Perceptibility Analysis

The Contrast Perceptibility Analysis is based on visual simulations. The contrast of the turbines and their surrounding landscape characteristics is assessed via representative photomontages. The analysis for the Project was done using photographs taken from various viewpoints (Map 5-2) presenting either representative Project Area Landscapes or valued viewpoints (Townscapes, Neubergthal, Highway 75, and TransCanada Trail). All visual simulations are presented in Appendix E. Viewpoints are listed in Table 5-15.

Representative Project Area Landscapes, including Townscapes

The analysis reveals that the contrast of the turbines with their surrounding landscapes will be low to medium for viewpoints which are representative of (i) the landscape in the Project Area and (ii) townscape viewpoints (Visual Simulations 1, 2, 3, and 4). For the majority of the views, the turbines in the background will not seem higher than the middleground, and because of the discontinuity of tree rows in the background and the middleground, the turbines will not be dominant in the viewshed.

In the case of village townscapes, it is expected that the relative height of the turbines will not be prominent in comparison with the foreground of these villages. For example, as shown on Visual Simulation 3, the majority of turbines around villages will be 3° above horizon. This relative height is not enough to be perceived as intrusive in a townscape characterized by a foreground that rises to 15° above the horizon.

The perception of the contrast between turbines and surrounding landscapes will be low to medium. The expected visual impact is therefore considered low, and not significant.

Highway 75 Landscapes

In the case of Highway 75 landscapes, it is expected that the relative height of most turbines will not be prominent in comparison with the foreground consisting of infrastructures along Highway 75. As shown in Visual Simulation 9, a few turbines will be prominent, but due to the mobility of the observer, the perception of this prominence will be of short duration. Generally, most turbines seen from Highway 75 will be less than 3° above the horizon. This relative height is not enough to be perceived as intrusive in a landscape characterized by a discontinuous foreground made of different elements that are higher than 15° above the horizon.

The perception of the contrast between turbines and surrounding landscapes will be low. The expected visual impact is therefore considered low, and not significant.

Neubergthal Landscapes

In the case of Neubergthal landscapes, it is expected that the relative height of the turbines will not be prominent in comparison with the foreground of this street village. As shown in Visual Simulations 5, 6, 7 and 8, the majority of turbines near Neubergthal will be 3° above the horizon. This relative height is not enough to be perceived as intrusive in the particular townscape of Neubergthal which is characterized by a rather continuous foreground (cottonwoods, densely built environments) and that rises higher than 15° above the horizon.

The perception of the contrast between turbines and surrounding landscapes will be low. Considering that turbines will be seen from relatively few viewpoints on the east side of the Village, and that consultation with representatives from the Village of Neubergthal resulted in the relocation of four turbines, the resulting expected visual impact on Neubergthal is considered low, and not significant.

TransCanada Trail Landscapes

In the case of the TransCanada Trail landscapes, it is expected that the relative height of the turbines will not be prominent in comparison with the middleground seen from this trail. Visual Simulation 5 is considered representative of a view from the TransCanada Trail in terms of visible turbine numbers and distances. The closest turbines will be less than 3° above the horizon. This relative height is not enough to be perceived as intrusive in a landscape which is characterized by a rather continuous middleground that rises between 2º and 3° above the horizon.

The perception of the contrast between turbines and surrounding landscapes is considered low and, considering the high sensitivity assessed earlier, the resulting expected visual impact on the TransCanada Trail is considered low, and not significant.

Table 5-15: Effect Assessment Summary – Landscape

Type of Viewscape	Visual Simulation #	Viewpoint	Value	Sensitivity	Contrast Perceptibility	Mitigation Measure	Residual Effect Level	Significance of Effect
Typical Agricultural Landscape	1	View from Altona Eigengrund Cemetery, looking North	Low	Low	Low	No turbine located within 550 m of dwellings.	Low	Not Significant
Typical Agricultural Landscape and Village Townscape	2	View from West Side of St. Joseph, Looking Northwest	Medium	Low	Medium		Low	Not Significant
	3	View from North End of St. Joseph, Looking North	Medium	Low	Low to medium		Low	Not Significant
	4	View from Letellier, Looking West	Medium	Low	Low		Low	Not Significant
Representative Viewpoint from National Historic Site and TransCanada Trail	5	View from Neubergthal Information Kiosk (Community Centre), looking East	High	Medium	Low	Four turbines were relocated to reduce the visual impact after consultation with Neubergthal Village and Parks Canada No turbine located within 3.2 km of the village No turbine located within 3.2 km of TransCanada Trail	Low	Not Significant
Valued Viewpoint from National Historic Site	6	View from the Balcony of Neubergthal Interpretive Centre	High	Medium	Low		Low	Not Significant
	7	View from Neubergthal Street Village Northern End (from the Church Parking Lot), Looking Northeast	High	Medium	Low		Low	Not Significant
	8	View from Backyard of P. Klippenstein Site, next to Neubergthal Cemetery, Looking East	High	Medium	Low		Low	Not Significant
Highway 75 Landscape	9	View from Highway 75, Looking Northeast	Medium	Low	Low	No turbine located within 250 m, and few within 1.5 km of Highway 75	Low	Not Significant

Note: Absorption Capacity: Medium
Insertion Capacity: Medium

Additional Note on Turbine Lighting

It is expected that for aviation safety, turbines will need to be lit according to Transport Canada guidelines. Lighting is required only for those structures that are over 150 m in height (which currently excludes all turbines). For structures between 90 m and 150 m, a Transport Canada assessment is required to determine lighting requirements, and for structures below 90 m, lighting is only required if they fall within a certain "airport obstacle limitation surface." Transport Canada regulations also allow for the Transportation Minister to individually assess any structure and modify lighting requirements as needed. For turbines requiring lighting based on the above guidelines, Transport Canada recommends red flashing beacons, but medium intensity white flashing obstruction lighting systems may be used instead of red obstruction lighting.

The lighting scheme of the Project will be based on Transport Canada guidelines (see Section 2). It is anticipated that the number of lights for the Project will be approximately 20 to 30, and that red or white flashing medium intensity lights will be used at night. Given this specification, visual impacts from the turbine lights are anticipated to be of low concern and not significant. Lighting requirements will also be discussed with CWS which recommends low-intensity flashing white lights at night to reduce bird collisions.

Shadow Flicker Analysis

Shadow flicker is defined as the alternating light intensity produced by a wind turbine as the rotating blade casts shadows on the ground and stationary objects, such as the window of a residence. Flicker will not occur when the turbine is not rotating, when the sun is obscured by clouds or fog, or when the rotor is not perpendicular to the "sun-receptor line of sight". A larger turbine rotor diameter will cast a larger shadow, meaning a larger area will be prone to incidences of shadow flicker. At distances of greater than approximately 500 metres between a turbine and a receptor, shadow flicker generally occurs only at sunrise or sunset when the cast shadows are extremely long. It is generally considered that 900 metres is the limit beyond which shadow flicker becomes insignificant or non-existent. Figure 5-1 shows an approximation of the shadow cast by a turbine at various times during the day, where the red shading represents the area where shadow flicker may occur.

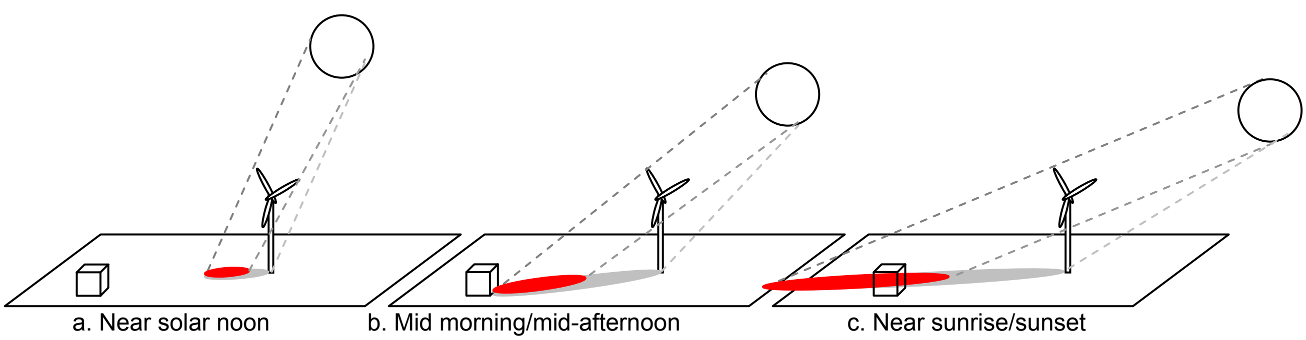


Figure 5-1: Schematic View of Shadow Flicker Conditions

Buildings to the north or south of wind turbines are less likely to receive shadow flicker than those to the east or west because shadows cast in the northerly and southerly directions are very short.

A worst-case scenario shadow flicker analysis has been performed for a radius of 1.5 km around every wind turbine. The following results were obtained:

- In the vicinity of the site, the receptor that would potentially experience the highest level of shadow flicker will be affected an estimated 39.8 hours per year, or 0.9 % of the time based on the number of daytime hours per year (4380 hrs) in ideal conditions.
- 113 receptors would experience less than 10 hours of shadow flicker per year.
- 39 receptors would experience between 10 and 19 total hours of shadow flicker per year.

- 21 receptors would experience between 20 and 29 total hours of shadow flicker per year.
- 7 receptors would experience between 30 and 40 total hours of shadow flicker per year.
- No receptor is located within 550 m of a turbine, therefore reducing the shadow intensity at the point of reception. It is important to note that the distinctiveness of the shadow is greatly blurred with distance: the farther the turbine is from the receptor, the more out of focus the shadow flicker becomes.

It is assumed that these values could have been further considerably reduced had the following factors been taken into consideration:

- Presence of trees, high vegetation or other obstacles between most houses and turbines;
- Periods of low or high wind speed (below 3 m/s or above 25 m/s, respectively), during which turbines will not be operational;
- The directional orientation of the wind turbines;
- General orientation of the windows for most houses.

Had all these variables been factored in, one might expect even fewer hours of shadow flicker at all houses studied.

Lastly, the following points should be borne in mind when interpreting the results of the shadow flicker analysis for the Project:

- The orientations used for the houses/windows are those considered to be the most representative of the ensemble of residences in the vicinity.
- Actual orientations of individual dwellings may vary.

For theses reasons, and given the few dwellings which could be potentially affected by shadow flicker for a limited number of hours per year, the anticipated impact is considered minimal.

5.15 Accidents and Malfunctions

Accidents and malfunctions could occur during any of the three project phases, i.e., construction, operation and decommissioning. Given that activities within the construction and decommissioning phases are very similar, these are generally treated jointly, as listed below and detailed in the following sections:

Construction/Decommissioning

- Worker accidents;
- Spills of hazardous materials;
- Vehicle collisions;
- Fire.

Operation

- Overheating or fire in nacelle;
- Oil spill from nacelles or transformers;
- Ice falls or throws;
- Blade break-up or fall;
- Tower failure;
- Mechanical failure;
- Electrical failure;
- Fire.

5.15.1 Accidents and Malfunctions: Construction/Decommissioning

5.15.1.1 Worker Accidents

Worker accidents can occur during the construction of wind energy projects, and are the most common type of accident related to wind projects. Nevertheless, an inventory of wind farm incidents indicates that only 14 deadly accidents have occurred in the world between 1970 and the early 1990s (Gipe, 1995). Incidents during construction are commonly associated with work undertaken at high elevation (e.g., work in or around the nacelle), heavy machinery operation and electrical network installation (AusWEA, 2004). Given these low incident numbers, the risk is considered to be very low.

To minimize the risk of accidents, St. Joseph Wind Farm will ensure that workers have adequate training and that construction activities are conducted with rigorously applied safety measures. Safety measures with respect to work in elevation will also be applied, namely to minimize the possibility of falls from the tower.

5.15.1.2 Spills of Hazardous Materials

As stated previously, the main hazardous substance that will be hauled on site during construction is diesel fuel. Fuel will be hauled to the Project site to supply heavy machinery, namely the cranes. Hauling of fuel and its presence on site create the possibility of spills on access roads and at turbine sites, potentially affecting vegetation and watercourses. The risk of such spills will be minimized by ensuring that all fuel trucks are inspected and in compliance with industry standards. Refuelling will follow accepted industry practices. All refuelling will occur at the crane pad or at designated refuelling sites, away from potential sensitive receptors. Designated refuelling and maintenance areas will be located away from vegetated areas. Emergency response spill kits will be maintained on site to contain any spill of hazardous fluids.

All hazardous material, including fuel, oils, and grease will be stored in designated areas.

5.15.1.3 Vehicle Collisions

Certain construction timeframes will be characterized by a significant increase in traffic on the site's access roads. Excess traffic could increase the possibility of collision with other vehicles.

To minimize potential traffic incidents, all construction teams and any other companies active on site will be required to have a two-way radio system for communication to avoid any potential collisions on access roads. The two-way radios will also be used to minimize circulation problems (e.g. exclusion of other vehicle traffic on sharp turns during transportation of the turbine blades).

Vehicles on the Project's access roads will have a maximum speed limit, thus limiting the potential for serious incidents on site and for collisions with wildlife. On public roads and highways, vehicles will abide by the posted speed limits.

5.15.1.4 Fire

If any brush waste is accumulated, it may be piled and burnt on site, or disposed as per local regulations. No burning of other materials or substances will be allowed on site. These will be disposed of in an approved facility.

5.15.2 Accidents and Malfunctions: Operation

The wind turbines benefit from an automatic controller system composed of various sensors that monitor temperature, pressure and electrical circuits of different components. In the event that a malfunction should occur, operation and maintenance personnel will be immediately notified of the situation thanks to an underground fibre optic communication system that links all the turbines in the wind farm to a centralized unit located off-site. This unit then informs on-site personnel of the situation, ensuring a prompt response in mobilising the appropriate resources.

The possible accidents or malfunctions and the planned response of wind farm technicians and other community-based resources are listed below.

5.15.2.1 Overheating or Fire in Nacelle

Modern wind turbines are conceived with proven state-of-the-art techniques to ensure safety and endurance. Fire is a rare occurrence with wind turbines, with documented cases being associated with faulty older turbine models (AusWEA, 2004). As the maintenance program will be diligently followed by the Proponent's and the Manufacturer's specialized teams, overheating or fire in the nacelle are not expected to occur. Additionally, the Project's automatic control system can rapidly detect any abnormal parameters and settings for each turbine and command an emergency stop if needed, thus limiting the possibility of overheating.

It should be noted that the nacelle is a closed component and given the types of material in the nacelle (fibreglass, steel, iron, rubber), fires with open flames would be very unlikely. Oils or lubricants that might ignite are more likely to produce a smouldering fire with thick smoke.

As open flames are not likely to be produced and most of the turbine materials are not combustible, the possibility of nearby groundcover, shrubs and trees catching fire is improbable. The concrete tower foundation and the cleared area around the turbines (e.g. access road) will help minimize the risk of ignition of natural vegetation or crops.

If a fire were to occur in a turbine, the turbine would stop automatically. The Proponent's maintenance staff would immediately deploy a team to the site to deal with the incident. If a ground fire were to occur, the maintenance crew would use the on-site fire control equipment to contain and extinguish the fire. The team supervisor would also contact the local fire department to report the incident and assess the need for further assistance or follow-up.

5.15.2.2 Oil Spill from Nacelles or Transformers

Turbines are equipped with retention gutters in the top part of the tower, capable of containing the amount of oil used by the nacelle components, which totals approximately 180 litres. These retention systems virtually eliminate the possibility of a spill into the environment.

Given these design specifications, only major circumstances (such as an extreme weather event) could create the possibility of an oil spill in the environment.

The Proponent has made an effort to avoid watercourses, waterbodies and sensitive ecosystems when positioning the Project's infrastructure, thus reducing the risk of impacts to the environment.

All oils and other substances will be stored in appropriate containers within fenced areas for the substations. Crews hauling and manipulating oils during maintenance activities will be trained to respond to spills and will have readily available spill response material.

5.15.2.3 Ice Falls or Throws

The formation of ice on turbine blades is a common concern in the industry as it can increase down-time and produce ice clusters that could fall or be projected from the blades, and thereby potentially injure humans and terrestrial fauna or damage nearby vegetation. Formation of ice is however a low-probability event that requires specific meteorological conditions to occur. About 25 to 50 hours of icing events occur per year in the region (Environment Canada, 2005), offering icing conditions potentially conducive to ice throws or falls.

In the event of ice formation, the most likely response is that the control system will detect an unbalance of the rotor and stop the affected turbine. In this case, ice falls would be limited to the area directly underneath and in the immediate vicinity of the turbine location.

Nevertheless, ice throws are known to happen, which is why the Tammellin et al. (1997) setback calculation, a distance equivalent to 1.5 times the sum of the hub height and the rotor diameter, is generally accepted in the industry in areas with notable icing conditions. In the present case, no turbine will be installed within 550 m of a dwelling, but some turbines are to be erected within 200 m of unpaved roads. Given that the Project is in a low density populated area, that no dwelling is within 550 m of a turbine, that the roads have low traffic densities and that icing conditions are rare, the probability of an incident is considered negligible.

5.15.2.4 Blade Break-up or Fall

Other turbine models with detachable blade tips have seen blade tips fall off or be thrown to a distance, but this is not the case for the turbines proposed for the Project, which have single-piece blades.

Blades can be damaged or broken by severe loads due to extreme winds, turbulence, wind shear and icing. An on-site evaluation of these extreme conditions is required by the turbine manufacturer. Extreme conditions must be within acceptable limits set by the manufacturer, as calculated using the IEC 61400-1 standard; a precise analysis will be undertaken before final siting of each turbine. No turbines will be placed in areas where turbine integrity would be jeopardized.

Additionally, such an incident resulting in injury has yet to occur in the world (Guillet and Leteurtrois, 2004). Given that the Project is located in a low density population area, human injury or fatality is considered to be highly improbable. Given the low probability of this type of incident, there is also negligible risk to wildlife.

5.15.2.5 Tower Failure

Tower failures can be associated with faulty foundation design and extreme weather conditions. Given that the Project is situated in low population density agricultural area, human injury or fatality is considered to be highly improbable.

The Proponent will ensure that foundations are designed to have the proper support strength for the type of terrain where the turbines are situated. The Proponent will undertake a geotechnical assessment of all turbine locations and modify turbine positions where risk is considered too high. Assuming that proper siting parameters result from these assessments, foundation or tower failure due to terrain is unlikely.

Tower failure can be induced by severe loads due to extreme winds, turbulence, wind shear and icing. An on-site evaluation of these extreme conditions is required by the turbine manufacturer, however. Extreme conditions must be within acceptable limits set by the manufacturer, as calculated using the IEC 61400-1 standard; a precise analysis will be undertaken before final siting of each turbine. No turbines will be placed in areas where turbine integrity would be jeopardized. Additionally, the turbine model was chosen to withstand the specific conditions on the site.

5.15.2.6 Mechanical Failure

Mechanical failure could occur for components of the nacelle, such as the gearbox, yaw system, braking system, generator, etc. If such an event were to happen, the control system would detect any of these failures and shut down the turbine. Repair crews would be notified to replace the faulty parts.

5.15.2.7 Electrical Failure

Electrical components inside the wind turbines such as electrical wires, circuit breakers, batteries, current transformers and transformers can suffer a failure due to short-circuits in the system. Failures of these components would result in loss of power for the Project, but no environmental damage or injury to the public is expected.

Failure to the overhead cabling or power line can occur due to lightning strikes, short-circuits, severe wind storms, tree fall or collision of vehicles with the supporting structures. Lines are equipped with protective relaying and lightning arresters that de-energize the affected line segment, thus minimizing injury possibilities to humans and wildlife, and minimizing the potential for fire in the lines’ right-of-way.

5.15.2.8 Fire

It is expected that, if needed, brush clearing will be performed every five years along the rights-of-way for the power lines and overhead electrical lines. Brush waste will be piled and burnt on site or disposed as per local regulations.

5.15.3 Accidents and Malfunctions Plan

The Proponent is committed to addressing and reacting to any emergency that should arise from an accident or a malfunction during the course of the Project’s service life, in order to safeguard the health and safety of its staff, the public and the environment. Particularly, the Proponent commits to the following:

- The Accidents and Malfunctions Plan will be presented to the local authorities to inform of and discuss the course of action taken in the event of an accident or a malfunction;

- In the event of a spill occurring at any time during the Project's service life, the Proponent will prioritize the safety of its employees on site and the surrounding communities, followed by protection of the environment.
- While the general responsibility of this Plan will be under the Proponent, the Construction Manager (for both construction and decommissioning) and the Operation Manager will have first-line authority to act upon accidents and malfunctions and provide for the necessary resources to address the issue.
- All public and media inquiries will be addressed in a timely fashion by the Proponent's Head of Public Relations.
- The Proponent will develop a monitoring program to verify compliance of all personnel, including contractor personnel, with the Plan.
- The Plan will be effective at the start of construction.
- The Plan will be reviewed periodically, namely once a year, and after every major accident or malfunction. Modifications to the Plan will be made if considered necessary to increase response effectiveness.

The Accidents and Malfunctions Plan will be structured around the following four main objectives:

- Understanding the type and extent of a potential accident or malfunction;
- Establishing a response plan commensurate with the risk, namely with respect to personnel and equipment required;
- Ensuring an orderly and timely decisional process;
- Providing an incident management organization with clear responsibilities.

The Plan will address all incidents that could potentially arise during the course of the Project's service life, from construction to decommissioning. It will cover all incidents that could arise in the general Project Area, which is an approximated zone around turbine sites, access roads and power lines. It is expected that most impacts of an accident or a malfunction during the Project's service life will happen in close proximity to the Project's infrastructure.

5.16 Cumulative Effects Assessment

Cumulative effects are defined as changes in the natural or human environment caused by an action associated with the Project under review, combined with other past, present and future human activities. The cumulative effects assessment (CEA) considered the following:

- Changes in the environment caused by the Project;
- The effects of any such changes on the component;
- Any changes to the Project caused by the environment.

5.16.1 Past, Present and Future Human Activities

Generally speaking, industrial or commercial activities in the RMs of Montcalm and Rhineland and the surroundings are mostly agricultural; industrial activity in the area is limited. The nearest wind energy project is the St. Leon Wind Farm, located approximately 100 km northwest of the Project (Map 1-1).

5.16.2 Cumulative Effects on Environmental Components

Since most activities in the immediate area of the Project are related to agriculture, natural areas have already been disturbed. The contribution to cumulative effects of the Project – which will result in the use of 186 ha of land and avoid any disturbance to natural areas (woodlots, wetlands, etc.) – is expected to be not significant. No cumulative effects are expected for any of the components listed below:

Biophysical Components

- Air and Climate;
- Terrain, Geology, Soils, and Drainage;
- Hydrogeology;
- Aquatic Ecosystems;
- Vegetation;
- Avian Fauna;
- Bats;
- Mammals;
- Reptiles and Amphibians.

Human Components

- Economics and Community Setting;
- Public Services and Infrastructure;
- Land Use;
- Archaeology and Heritage Resources;
- Acoustic Environment;
- Landscape.

6 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

6.1 Meteorological Conditions

6.1.1 Extreme Winds

Blades can be damaged or broken by severe loads due to extreme winds, turbulence, or wind shear. Although the Project is not located in areas of extreme winds, an on-site evaluation of extreme conditions is nonetheless required by the turbine manufacturer to confirm wind conditions. Extreme conditions must be within acceptable limits set by the manufacturer, as calculated using the IEC 61400-1 standard; a precise analysis will be undertaken before the final siting of each turbine. No turbines will be placed in areas where turbine integrity would be jeopardized, thus minimizing this potential effect of the environment. Wind turbines are also equipped with a safety feature. Typically, if wind speeds reach 20 m/s for a sustained period of 1 minute or 32 m/s for a sustained period of 1 second (not classified as “extreme winds”) at a given turbine, the control system will switch it off automatically. The turbine will resume operation once wind speeds fall below a predetermined speed.

6.1.2 Ice

During ice storms or periods of icing, ice can accumulate on the blades and reduce the energy output of the turbine. This is caused by the alteration of the shape of the blades by the ice, which causes a loss of energy production due to friction and/or by a stoppage of the wind turbine if the weight of the ice throws the rotor off balance. About 25 to 50 hours of icing events occur per year in the region, offering icing conditions potentially conducive to ice throws or falls. It should be noted that such potential losses of energy due to ice accumulation on the blades in the winter months have already been factored into energy calculations previously made for the Project.

6.1.3 Extreme Temperature

The proposed turbine to be used will be capable of operating under very low (-30°C) temperatures. Turbines are stopped if temperatures reach this level, and restart again when the temperature rises above -30°C. This type of wind turbine has been proven in meteorological conditions similar to those that characterize the Project Area.

6.1.4 Climate Change

As recently stated by the Intergovernmental Panel on Climate Change (IPCC SPM 2007 report), “warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level”. Climate change is therefore evident on a global level, such that it is necessary to envisage to what extent this phenomenon might affect the Project, the main issues being icing, terrain stability, and winds.

According to the IPCC predictions, winters at northern latitudes are expected to be milder; icing conditions could therefore occur more frequently. In the event of increased icing due to climate change, longer or more frequent down periods and thus slight decreases in energy yield might be expected.

Heavier precipitation may also increase runoff and the risk of landslides; however, the siting of turbines and access roads will avoid unstable terrain areas in order to limit potential future impacts on the Project.

6.2 Other Phenomena

6.2.1 Fire

The probability that a fire might pose a threat to the equipment is reduced because of the cleared area at the base of each wind turbine and the open space associated with agricultural fields. Fire can still be propagated by brush that will have grown on the cleared areas, but the risk is considered minimal.

6.2.2 Lightning

The wind turbines are equipped with a grounding system that prevents damage potentially caused by lightning. Each blade is equipped with a copper wire running from its tip to the hub and nacelle and then down the tower to a ground grid in the tower's foundation. The nacelle is topped by a lightning rod which is also connected to the ground grid.

6.2.3 Seismic Hazard

Structures will be designed to meet the earthquake loads for the area as per the Canadian Building Code. The Project Area is located in a low hazard zone (NRCan, 2005).

6.2.4 Flooding

The eastern portion of the Project Area, nearest to the Red River, is located in the 1997 Red River Valley flooded area (Manitoba Water Stewardship, 1997). Other flooding events may occur during the operation phase of the Project. If the transformers are to be located at the base of the towers instead of within the nacelle, specific measures to prevent any damage to transformers due to flooding events will be implemented.

7 SUMMARY OF COMMITMENTS

This section summarizes the commitments from the Proponent for mitigation measures and follow-up/monitoring. The details of these commitments are found in the mitigation and follow-up and monitoring sub-sections for each environmental or social component, presented in Section 5.

7.1 Summary of Commitments

Table 7-1: Summary of Commitments per Project Phase

Targeted Component	Description
	CONSTRUCTION
Air and Climate	C1 Water or a water-based dust suppressant will be used to control dust on Project access roads and utilized public roads within Project limits.
Air and Climate; Terrestrial Fauna	C2 Speed of traffic will be reduced on unpaved roads.
Air and Climate	C3 Trucks and machinery will be inspected for compliance with emission standards.
Air and Climate	C4 Efficient transportation will be maintained as much as possible during construction and decommissioning.
Terrain, Soils and Groundwater	C5 Geotechnical investigation will be conducted prior to any soil/rock excavation and blasting.
Terrain, Soils and Groundwater	C6 Information on soil quality, drainage and groundwater conditions at turbine and road locations will be obtained through subsurface investigations.
Terrain, Soils and Groundwater	C7 Disturbed areas will be restored (e.g. vegetated or reseeded with appropriate seed mix; recontoured to compliment pre-construction drainage patterns, etc.).
Terrain, Soils and Groundwater	C8 Salvaged subsoil will be replaced and capped with topsoil and salvaged organic material, including woody debris.
Terrain, Soils and Groundwater	C9 Adequately designed culverts and surface drains will be installed for all new access roads.
Terrain, Soils and Groundwater; Aquatics; Vegetation	C10 Sediment and erosion control measures will be implemented as required in areas of erosion risk.
Terrain, Soils and Groundwater	C11 Soil tillage practices and overturning on compacted soil will be implemented.
Aquatic Resources	C12 Activities near watercourses and waterbodies will be conducted according to federal and provincial regulations and guidelines.
Aquatic Resources	C13 Whenever trees and shrubs are removed from watercourse corridors at crossing locations, they will be replanted on upstream and downstream sides of the crossings in order to minimize the extent of the effect.
Aquatic Resources	C14 Culverts will be countersunk below the level of the substrate to avoid creating a vertical barrier at the outlet of the pipe.
Aquatic Resources	C15 Culvert lengths and their slope will be kept to a minimum.
Aquatic Resources	C10 Sediment and erosion control measures will be implemented as required in areas of erosion risk. C16 A 15-m buffer from the top-of-bank of any drain, creek or river will be respected such that no other than construction (or decommissioning) activity occurs in the buffer.

Targeted Component	Description
Aquatic Resources	C17 Timing windows for in-water works will be respected.
Aquatic Resources	C18 Culverts will not be installed when flows are high.
Aquatic Resources	C19 Culvert installation will use accepted methods for working in dry conditions.
Aquatic Resources	C20 Electricity transmission line crossings will either be incorporated into the road bed, employ a directional bore method, be installed as overhead lines, or be installed with trenching methods in the absence of flow.
Aquatic Resources	C21 Standard sediment and erosion controls will be implemented and maintained for the duration of the disturbance.
Aquatic Resources; Vegetation	C22 An Environmental Management Plan (EMP) will be implemented as guidance for the contractor to minimize environmental impacts.
Vegetation	C23 All site staff will be trained on implementing the plans and procedures contained within the EMP.
Vegetation	C24 Settling ponds or filter bags will be used to remove sediment prior to discharge of water where necessary.
Vegetation; Avian Fauna; Bats; Terrestrial Fauna	C25 Vegetation clearing will be used only when necessary and will be limited to hedgerow habitats.
Vegetation	C26 Proper arboricultural techniques will be used in the removal or pruning of any tree, including limbs and roots.
Avian Fauna	C27 Whenever possible, timing of work in close vicinity to woodlots will occur outside the core bird nesting period (in forested habitat, 24 May to 31 July). *Migratory Birds Convention Act* prohibition periods may be required.
Avian Fauna	C28 If clearing must occur within nesting period, a trained biologist should inspect the proposed work area for nesting birds prior to any site clearing.
Avian Fauna	C29 Trees with large stick nests will be left undisturbed.
Bats	C30 Significant bat habitat, including snags, will be avoided during clearing of any vegetation.
Terrestrial Fauna; Acoustic Environment	C31 Construction activities will mostly occur during daylight hours and will be limited in terms of duration.
Terrestrial Fauna	C32 Where required, sight-line considerations will be used to maximize reaction time for vehicle drivers and wildlife.
Economic and Community Setting	C33 A program for training local populations and First Nations will be implemented in order to provide job opportunities to local people.
Economic and Community Setting; Land Use	C34 Affected landowners will be compensated.
Public Services and Infrastructure	C35 Construction and traffic management plan: the Proponent will inform local and regional authorities of its transportation plan to avoid any unexpected circulation problems; this plan will include the construction schedule, convoy schedule and density, types of vehicles, etc.
Public Services and Infrastructure	C36 Segments used during construction in the vicinity of the Project Area will be upgraded and improved.
Land Use	C37 After construction and decommissioning, temporary work areas will be returned to their initial state through the site reclamation strategy. C38 The proposed schedule will be respected as much as possible such that project-related activities take place during periods of low agricultural activity. C39 Workers will remain, as much as possible, within the delimited Project footprint. C40 Whenever possible and when preferred by landowners, existing gates at the entrance of access roads will be secured with different locks.
Archaeological and	C41 An archaeological field survey will be considered prior to construction of WTG structures

Targeted Component	Description
Heritage Resources	located less than 1 km from a known archaeological and/or cultural heritage site. C42 Particular cautions will be taken at WTG sites close to the settlement of St. Joseph. C43 Should human remains be found during any component of the Project, all work at that location will halt and the Historic Resources Branch will be called immediately. C44 As a cautionary measure, workers will be made aware of the potential presence of heritage resources in sensitive areas. If evidence of heritage resources is found, a field archaeological survey will be conducted.
Acoustic Environment	C45 Nearby residents will be advised of significant truck transportation passing through provincial and municipal roads.
Acoustic Environment	C46 All internal combustion engines will be fitted with appropriate muffler systems.
	OPERATION
Terrain, Soils and Groundwater	O1 Access roads width will be limited to 5 m at turbine sites and turbine sites will be restored.
	O2 Excess road width and temporary working areas will be tilled and turned over after construction.
Avian Fauna	O3 Landowners will be advised to keep habitats in proximity to turbines in active agricultural state to minimize hunting and nesting activities in close proximity.
Avian Fauna	O4 The proposed turbine layout considers potential bird movement between large woodlots or wetland communities.
Avian Fauna	O5 Single wooden pole structures will ensure that power lines are on same level and minimize the potential for collisions.
Avian Fauna	O6 Pole heights will not extend far above the canopy of adjacent forest communities and will decrease potential for collisions with migrants.
Avian Fauna - Bats	O7 Lighting of towers and use of strobe lighting will be kept to minimum allowable levels. Discussions with Transport Canada will be held to encourage the use of white flashing lights at night.
Economic and Community Setting	O8 A program for training and job opportunities will be implemented for local populations and First Nations.
Economic and Community Setting	O9 A compensation program will be implemented for affected landowners.
Economic and Community Setting	O10 An annual donation will be given to St. Joseph Museum.
Acoustic Environment	O11 Compliance with Manitoba Conservation requirements (and CanWEA noise guidelines) was considered as criteria for the Project layout design.
	DECOMMISSIONING
Terrain, Soils and Groundwater	Same as C8, C10, and C11
Aquatic Resources	Same as C10, C16 C17, C21, C22, C23, and C24
Vegetation	Same as C10, C22, C23, and C24
Avian Fauna	Same as C25, C27, and C28
Terrestrial Fauna	Same as C2, C31, and C32
Economic and Community Setting	Same as C33 and C34
Public Services and Infrastructure	Same as C35

Targeted Component	Description
	ACCIDENTS AND MALFUNCTIONS
Terrain, Soils and Groundwater; Aquatics; Vegetation	A&M1 Contractor will have an Emergency Response Plan (ERP) in place in accordance with the Environmental Management Plan (EMP).
Terrain, Soils and Groundwater; Aquatics; Vegetation	A&M2 All crews will be trained on proper implementation of the ERP, including accidental spills response.
Terrain, Soils and Groundwater; Aquatics; Vegetation	A&M3 All crews will have spill clean-up materials on hand at all times.
Terrain, Soils and Groundwater; Aquatics; Vegetation	A&M4 Trucks and heavy machinery will be inspected on a regular basis to minimize the potential for accidental releases of toxic fluids (hydraulic fluids, coolant, etc)
Terrain, Soils and Groundwater; Aquatics; Vegetation	A&M5 Designated refuelling/maintenance areas will be environmentally secure and located away from watercourses and waterbodies.
Terrain, Soils and Groundwater; Aquatics; Vegetation	A&M6 Hazardous materials will be stored in designated secure areas.
Terrain, Soils and Groundwater; Aquatics; Vegetation	A&M7 Operational control procedure for storage and handling of hazardous materials will be implemented and all construction staff will be trained on proper implementation of this procedure.
Public Services and Infrastructure	A&M8 Accidents and Malfunctions Plan: Industry-standard safety measures to reduce the risk of work-related accidents will be implemented.

Table 7-2: Summary of Follow-up and Monitoring Measures

Targeted Component	Description
Terrain, Soils and Groundwater	An environmental monitor will be present on site, during construction and decommissioning activities, to ensure that all measures are applied to limit any potential effects. As a follow-up measure, landowners will be consulted after construction to ensure no effects from the construction activities remain.
Aquatic resources Vegetation	Environmental supervision during construction and decommissioning as part of a routine inspection program will be implemented to ensure adherence to the prescribed mitigation measures. Environmental supervision is especially recommended during key components of the construction phase. Monitoring will be carried out routinely to ensure soil stabilization and early identification of runoff and erosion.
Avian Fauna	If construction or decommissioning activities must occur within the nesting period, prior to any site clearing a trained biologist should inspect the proposed work area for nesting birds, identify and delineate work zones prior to undertaking work, and regularly inspect the extent of the work to ensure that the spatial extent of the work is minimized. Post-construction monitoring consisting of mortality monitoring by means of systematic carcass searches is recommended. In addition to mortality monitoring, scavenger surveys are also recommended, and all mortality searchers should be tested for searcher efficiency. The monitoring protocol will be developed in conjunction with Environment Canada, Manitoba Conservation, and other federal regulatory agencies such as NRCan.
Bats	Post-construction monitoring should be conducted. Post-construction monitoring consists of mortality monitoring by means of systematic carcass searches, and could be conducted in conjunction with avian post-construction monitoring. In addition to mortality monitoring, scavenger surveys are also recommended, and all mortality searchers should be tested for searcher efficiency. The monitoring protocol should be developed in conjunction with Environment Canada, Manitoba Conservation, and other provincial or federal regulatory agencies such as NRCan.

8 CONCLUSION

St. Joseph Wind Farm Inc. is proposing to develop a wind energy project having a maximum of 200 wind turbine generators (WTG), for an installed capacity of 300 MW. The Project is located in the vicinity of the town of St. Joseph, approximately 85 km south of Winnipeg, and overlaps the Rural Municipalities of Rhineland and Montcalm. The turbines are distributed over an area of approximately 215 km^2 of agricultural land.

This Environmental Assessment is required under the *Canadian Environmental Assessment Act* because Natural Resources Canada may provide financial assistance to the Proponent through the ecoENERGY Program for the purpose of enabling the Project. The Project is also subject to review and licensing under the *Manitoba Environment Act* as a Class 3 development for which a Proposal must be submitted. Therefore, this Environmental Impact Study Report has been submitted to the Canadian Environmental Assessment Agency, and has been filed as a Proposal to Manitoba Conservation.

Environmental studies were conducted according to the requirements of the CEAA, guidelines and consultation from various regulatory agencies. Field investigations were conducted from April 2007 to May 2008. The Environmental Assessment was conducted by a team of qualified specialists from various disciplines, who conclude that the St. Joseph Wind Energy Project will not have any significant biophysical or social effects, provided that the proposed mitigation measures are applied.

Generally speaking, the Project is not located in an area considered to be sensitive with respect to the natural environment, and no species at risk were found on site. Detailed site assessments were also undertaken to ensure minimal effects to watercourses and agricultural land. The Project layout was carefully designed to respect and exceed setbacks commonly used in the industry with respect to distances from inhabited areas, roads, watercourses, known archaeological and/or cultural heritage sites, etc. A noise simulation was conducted to ensure the acoustic environment would not be significantly affected by the Project at surrounding dwellings.

The Project is also in line with climate change, clean air and energy policies of the provincial and federal governments, in that it is expected to reduce the need for fossil fuel-based generation. With a current Capital Cost estimated at more than $600M when built to maximum size, the Project will provide reliable clean energy, as well as create specialized regional employment opportunities in renewable energy. The Project can also provide a regional platform for promoting the renewable energy sector throughout Manitoba. It is expected that the Project will create 200 to 300 jobs during the preparation and construction phases and some 15 long-term skilled jobs during the operational phase.

The Proponent is also committed to a set of mitigation measures and post-construction programs that aim to minimize and monitor any potential effects. Most importantly, the Project has benefited from several consultations with local authorities, land users and local residents to ensure that it is built to minimize environmental and social effects, while maximizing energy generation.

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