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**BROOKE-ALVINSTON WIND FARM
DESIGN AND OPERATIONS REPORT**

Appendix D

Environmental Effects Monitoring Plan



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**BROOKE-ALVINSTON WIND FARM
ENVIRONMENTAL EFFECTS
MONITORING PLAN FOR WILDLIFE**

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1.0 Introduction

Zephyr Farms Limited (Zephyr Farms) is proposing to develop the Brooke-Alvinston Wind Farm (the Project) in the Township of Brooke-Alvinston, Lambton County, Ontario. The Project has been awarded a Power Purchase Agreement with the Ontario Power Authority (RESOP 11836). The basic components of the Project include four Samsung Heavy Industries 2.5 MW wind turbine generators for a total installed nameplate capacity of 10 MW, transformers at each turbine, electrical collector lines and fibre optic data lines, a switchyard with associated control room, a meteorological tower (met tower) and associated power and data cabling, and turbine access roads. The electrical transmission system would transport the electricity generated from each turbine to Hydro One Networks Inc.'s (HONI's) distribution network. The Project also includes interconnection equipment and installations specified by HONI. All Project components will be situated on private land and municipal road allowance.

Zephyr Farms has retained Stantec Consulting Ltd. (Stantec) to prepare a Renewable Energy Approval (REA) Application, as required under Ontario Regulation 359/09 - Renewable Energy Approvals under Part V.0.1 of the Act of the *Environmental Protection Act* (O. Reg. 359/09). According to subsection 6(3) of O.Reg.359/09, the Project is classified as a Class 4 Wind Facility and will follow the requirements identified in O.Reg.359/09 for such a facility.

This Post-Construction Monitoring Plan is one component of the Mitigation and Environmental Effects Monitoring Plan (EEMP) of the REA Application for the Project, and has been prepared in accordance with O. Reg. 359/09, the Ontario Ministry of Natural Resources' (MNR's) *Approval and Permitting Requirements Document for Renewable Energy Projects* (September 2009), the Ministry of the Environment's (MOE's) draft *Technical Bulletin Two: Guidance for preparing the Design and Operations Report* (March 2010), MNR's Draft *Bats and Bat Habitats: Guidelines for Wind Power Projects* (March 2010) and MNR's *Birds and Bird Habitats: Guidelines for Wind Power Projects* (October 2010).

As discussed in the Project's Natural Heritage Assessment (NHA), primary data was collected in the Project Study Area pre-construction. This data was augmented with secondary data from published and unpublished sources to generate a dataset from which to assess the potential effects of the Project. No bird or bat significant wildlife habitat was identified in the Project Location (NHA, Section 4.0); however, post-construction mortality surveys are required for all Class 3 and 4 wind power projects (MNR 2010a and MNR 2010b).

The purpose of this EEMP is to verify compliance of the Project with applicable provincial and federal legislation and guidelines. This monitoring plan provides details on the post-construction wildlife monitoring program for mortality monitoring birds and bats.

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2.0 Post-Construction Monitoring Program

2.1 PURPOSE AND TIMING

The purpose of the wildlife post-construction monitoring program is to identify performance objectives, assess the effectiveness of the proposed mitigation measures and to identify contingency measures that will be implemented if performance objectives cannot be met. Furthermore, any unanticipated potentially significant adverse environmental effects discovered during the post-construction monitoring program will be mitigated as described in Section 3.0. No bird or bat significant wildlife habitat was identified in the Project Location (NHA, Section 4.0); however, post-construction mortality surveys are required for all Class 3 and 4 wind power projects (MNR 2010a and MNR 2010b).

The Environmental Effects Monitoring Plan for wildlife at the Brooke-Alvinston Wind Project includes the following:

- *mortality monitoring for birds and bats*: twice weekly (3-4 day intervals) mortality monitoring at all turbines from May 1 to October 31, and weekly monitoring for raptors during November, for a period of three years. Searcher efficiency and scavenger trials will be conducted each year according to current guidance documents.

2.2 PRIMARY DATA COLLECTION

Detailed monitoring methods, including duration and frequency are discussed below.

2.2.1 Bird Mortality Monitoring

Background

The Project Location does not contain any factors (i.e. colonies, staging areas, migration corridors) that elevate its risk to birds. It is considered a low sensitivity site, representing the lowest level of potential risk to birds.

Monitoring

Bird mortality monitoring will be conducted according to MNR's *Birds and Bird Habitats: Guidelines for Wind Power Projects* (2010a).

Mortality monitoring within minimally-vegetated portions (i.e., Visibility Classes 1 and 2 [MNR, 2010b]) of a 50 m search area radius from the base of all wind turbines will be conducted twice-weekly (3-4 day intervals) between May 1 and October 31 for a period of three years. A weekly mortality survey will be conducted at all turbines in November to assess raptor mortality.

Although all reasonable efforts will be made to conduct surveys as scheduled, surveys will not be conducted if weather (e.g. lightning, severe fog) presents safety concerns. Weather

conditions will be noted when surveys were not conducted as scheduled, and every attempt will be made to complete the missed survey(s) as soon as possible.

Searcher efficiency and scavenger trials will be conducted in accordance with Environment Canada (EC) and MNR guidelines. Searcher efficiency trials will typically be conducted once in each of spring, summer and fall, but will be repeated if searchers change during the year. Searcher efficiency trials are designed to correct for carcasses that may be overlooked by surveyors during the survey periods. Searcher efficiency trials involve a “tester” that places bird and bat carcasses under turbines prior to the standard carcass searches to test the searcher’s detection rate. Trial carcasses will be discreetly marked so they can be identified as study carcasses. Each trial will consist of a minimum of 10 carcasses per searcher per visibility class. Searcher efficiency (Se) is calculated for each searcher as follows:

$$Se = \frac{\text{number of test carcasses found}}{\text{number of test carcasses placed} - \text{number of test carcasses scavenged}}$$

Scavenger trials will be conducted once a month (May-Oct) and will involve 10 carcasses of bird and bat turbine fatalities, if available, or dark-coloured poultry chicks. If available, at least one raptor carcass will be used for some trials. Carcasses will be discreetly marked so they can be identified as study carcasses. Scavenger trials are designed to correct for carcasses that are removed by predators before the search period. These trials involve the distribution of carcasses in habitat types being searched, at known locations at each wind turbine generator, followed by periodic checking to determine the rate of removal. Proportions of carcasses remaining after each search interval are pooled to calculate the overall scavenger correction factors:

$$Sc = \frac{n_{\text{visit1}} + n_{\text{visit2}} + n_{\text{visit3}} + n_{\text{visit4}}}{n_{\text{visit0}} + n_{\text{visit1}} + n_{\text{visit2}} + n_{\text{visit3}}}, \text{ where}$$

Sc is the proportion of carcasses not removed by scavengers over the search period

n_{visit0} is the total number of carcasses placed

n_{visit1} – n_{visit4} are the numbers of carcasses remaining on visits 1 through 4

There are numerous published and unpublished approaches to incorporating these corrective factors into an overall assessment of total bird and bat mortality. The estimated mortality will be calculated as follows:

C = c / (Se x Sc x Ps), where:

- **C** is the corrected number of bird or bat fatalities;
- **c** is the number of carcasses found;
- **Se** is the proportion of carcasses expected to be found by searchers (searcher efficiency);
- **Sc** is the proportion of carcasses not removed by scavengers over the search period; and
- **Ps** is the percent of the area searched.

Most birds and bats will fall within 50 m of the turbine base (MNR 2010a). This value will be used to determine the percent of area searched (Ps). When the entire 50 m radius search area is searched, Ps will equal 100%. If portions of the 50 m radius search area are impossible due to site conditions (such as agricultural crops) Ps will be adjusted accordingly based on the searchers' ongoing estimates of the proportion of the search area that was physically searched. An alternative option is to use a GPS to delineate the search area and calculate the Ps.

The area searched will be determined for each turbine by mapping searchable areas on a grid (by visibility class) and counting the number of searched grid cells within 50 m. Maps of the varying search areas will be made available to review agencies. The summed area of those cells will be divided by the total area within a 50 m radius circle to determine the percent area searched for that turbine (Ps_x, where x is the turbine number).

$$Ps_x = \frac{\text{area searched within 50 m radius circle}}{7854 \text{ m}^2}$$

The overall Ps for the facility will be calculated as the average of Ps₁ through Ps₄.

Observed fatalities will be photographed, and the species, GPS coordinates, substrate, carcass conditions, and distance and direction to the nearest turbine will be recorded along with the date, time and searcher. This approach to mortality monitoring will facilitate any potential correlation between mortality occurrences, turbine location, habitat/land use features, and season.

Bird carcasses in good condition may be collected and stored in a freezer for future use in searcher efficiency and/or scavenger removal trials. Persons handling bird carcasses will take reasonable precautions (e.g. gloves, tools etc.) to protect their personal health. Bird carcasses

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will be placed in heavy-duty plastic bags and transported that day to a freezer, where they will be stored until required for the trials. Carcasses of any species covered under the *Endangered Species Act, 2007* (“ESA”) or the federal *Species at Risk Act* (“SARA”) will be collected in a manner consistent with the conditions of applicable permits (see below). All other bird carcasses will be left in place and noted to avoid double-counting during future searches.

As of 30 June 2008, species that are extirpated, endangered, or threatened are protected under the *ESA*. Consequently, unless otherwise authorized, possession and transport of species at risk is prohibited under the *ESA*. Therefore, in order to carry out the various activities contemplated in this Plan, a permit under clause 17(2)b of the *ESA* is necessary to allow Zephyr Farms and its agents to collect, possess, and transport species at risk as obtained from the Project Study Area. Any conditions attached to the permit relating to handling of injured birds, including raptors and species at risk, will be adhered to.

Additionally, in support of the activities contemplated in this Plan, Zephyr Farms or its agents will apply for a scientific collector’s permit under the *Fish and Wildlife Conservation Act* (“*FWCA*”) from the MNR that would allow Zephyr Farms and its agents to possess and transport a species protected by this legislation.

Finally, Zephyr Farms or its agents will apply to EC (Canadian Wildlife Service) for a scientific collector’s permit under the *Migratory Bird Convention Act, 1994* (*MBCA*) that would allow Zephyr Farms and its agents to collect, possess, and to utilize for scientific research purposes, deceased specimens of migratory birds obtained from the study area.

Other permits, approvals, authorizations, etc., are not likely to be required from the MNR or EC to permit the monitoring activities contemplated in this Plan.

2.2.2 Bat Mortality Monitoring

Background

Bat mortality has been documented at wind power facilities in a variety of habitats across North America. Nearly every monitored wind power facility in the United States and Canada has reported bat mortality with minimum annual mortality varying from < 1 to 50 bat fatalities/turbine/year (MNR 2006). The majority of bat fatalities at wind power facilities occur in the late summer and fall, and the long-distance migratory bats (i.e., hoary bat, eastern red bat, silver-haired bat) appear to be most vulnerable to collisions with moving turbine blades. Specific factors causing bat mortality and affecting species vulnerability to wind turbine mortality remain unclear, although recent evidence from Alberta suggests that air pressure differences in the blade vortices may contribute to bat mortality. Ontario specific data is relatively sparse at this time. Current evidence from operating facilities in Ontario suggests that bat mortality is lowest in open farmland away from forests and major waterbodies (MNR 2010b).

Monitoring

Bat mortality monitoring will be conducted according to MNR's *Bats and Bat Habitats: Guidelines for Wind Power Projects* (2010b). In general, the mortality monitoring requirements for bats will be captured in conjunction with bird mortality monitoring (described above).

- Bat mortality monitoring will be conducted twice-weekly (3-4 day intervals) within minimally-vegetated portions (i.e., Visibility Classes 1 and 2 [MNR, 2010b]) of a 50 m search area radius from the base of all turbines between May 1 and September 30 for a three-year period in accordance with MNR guidelines. This time period includes the core season when resident and migratory bats are active. Bat mortality monitoring will be conducted in conjunction with other monitoring activities (birds) for efficiency.
- Searcher efficiency trials will be conducted seasonally and carcass removal trials will be conducted monthly between May 1 and September 30. Searcher efficiency and carcass removal rates are known to be more variable for bats than for birds throughout the year and depending on habitat (in part due to the relative size of the species).

As with birds, trial carcasses will be discreetly marked so they can be identified as study carcasses. Each trial will consist of a minimum of 10 carcasses per searcher per visibility class (for searcher efficiency trials) or per trial (for scavenger removal trials). At least one-third of the trial carcasses should be bats.

Bat carcasses in good condition may be collected and stored in a freezer for future use in searcher efficiency and/or scavenger removal trials. Persons handling bat carcasses will take reasonable precautions (e.g., gloves, tools etc.) to protect their personal health. All searchers will ensure they have updated rabies pre-exposure vaccinations. Biological material will be disposed of in a way to ensure that it does not pose a public or environmental health risk and in accordance with any applicable federal, provincial, and municipal laws.

2.3 Reporting and Review of Results

Annual post-construction monitoring reports will summarize and analyze the results of mortality surveys. Reports will be submitted to the MOE within three months of the conclusion of the November mortality monitoring.

The monitoring program will be reassessed by MNR and Zephyr Farms at the end of each monitoring year. Pending the reassessment results, the program methods, frequencies, and duration may be reasonably modified to better reflect the findings.

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3.0 Adaptive Management Program

The adaptive management program described in this section outlines performance objectives, and contingency measures, that will be implemented should the performance objectives not be met.

Contingency measures may include an adaptive management approach. An adaptive management program allows mitigation measures to be implemented in the event that unanticipated potentially significant adverse environmental effects are observed. Potentially significant adverse effects will be assessed through review of the annual report.

All bird and bat mortality will be reported in the annual report submission. Mortality rate is expressed as the number of fatalities per turbine per year (e.g. from May 1 to November 30). A threshold approach will be used to identify and mitigate potential negative effects resulting from the operation of wind turbines.

3.1 BIRDS

Post-construction mitigation, including operational controls, will be considered if annual mortality (e.g. from May 1 to November 30) of birds exceed the following thresholds defined by the MNR:

- 18 birds/ turbine/year at individual turbines or turbine groups; and
- 2 raptors or vultures/wind power project (<10 turbines).

Or if bird mortality during a single mortality monitoring survey exceeds:

- 10 or more birds at any one turbine; or
- 33 or more birds (including raptors) at multiple turbines.

Any and all mortality of species at risk (i.e., a species listed as Endangered, Threatened or Special Concern under Schedule 1 of the federal Species at Risk Act or a species listed on the Species at Risk in Ontario list as Extirpated, Endangered, Threatened, or Special Concern under the provincial Endangered Species Act, 2007) that occurs will be reported immediately to EC and/or the MNR.

If with due consideration of seasonal abundance and species composition, annual mortality levels exceed the thresholds noted above, Zephyr Farms or its agents will conduct two years of subsequent mortality monitoring at all four turbines (MNR 2010a).

If significant annual mortality persists, MNR will be engaged to initiate an appropriate response plan as set out in the MNR's Bird Guidelines (2010a), which may include some or all of the

following mitigation measures (or alternate plan reasonably agreed to between Zephyr Farms and the MNR¹):

- Increased reporting frequency to identify potential threshold exceedance in a timely way;
- Behavioural studies to determine factors affecting mortality rates;
- Periodic shut-down of select turbines at specific times of year (MNR, 2010a); and
- Blade feathering at specific times of year (MNR, 2010a).

3.2 BATS

Operational mitigation is required where annual post-construction mortality monitoring exceeds 10 bats per turbine per year (MNR 2010b).

Operation mitigation to be implemented includes increasing cut-in speed to 5.5 m/s or feathering wind turbine blades when wind speeds are below 5.5 m/s between sunset and sunrise, from July 15 to September 30, as set out in the MNR's Bat Guidelines (2010b).

¹ An alternate plan maintains flexibility within the Plan to consider alternative response ideas that may arise over the course of the Plan (e.g., new technologies that may reduce bird or bat fatalities).

4.0 Best Management Practices

Zephyr Farms will include the following best management practices as part of the post-construction monitoring program (as outlined in MNR 2010b).

4.1 DATA MANAGEMENT

All post-construction data, collected in accordance with MNR guidance and reported to MOE, will be made available for entry into the joint Canadian Wildlife Service – Canadian Wind Energy Association – Bird Studies Canada – Ontario Ministry of Natural Resources Wind Power and Birds Monitoring Database.

4.2 WHITE-NOSE SYNDROME

Carcasses of the following species found during bat mortality searches may be sent to the Canadian Cooperative Wildlife Health Centre for analysis of White-nose Syndrome and should not be used in carcass removal or searcher efficiency trials.

- *Myotis septentrionalis*
- *Myotis lucifugus*
- *Myotis leibii*
- *Perimyotis subflavus*
- *Eptesicus fuscus*

4.3 BAT TISSUE SAMPLES

Tissue samples from bat carcasses may be used in a number of DNA analyses to provide insight into population size and structure, as well as the geographic origin migrants. Zephyr Farms will contact the local MNR office prior to disposing bat carcasses, to determine if this type of research is occurring in the area.

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5.0 References

- Ontario Ministry of Natural Resources. 2006. Wind Turbines and Bats: Bat Ecology Background Information and Literature Review of Impacts. December 2006.
- Ontario Ministry of Natural Resources. 2007. Guideline to Assist in the Review of Wind Power Proposals: Potential Impacts to Bats and Bat Habitats (Working Draft). 28 pp.
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