Wind Turbines and Birds
A Guidance Document for Environmental Assessment

March 2006

V. 6

Environment Canada
Canadian Wildlife Service

Wind Turbines and Birds

A Guidance Document for Environmental Assessment

Environment Canada / Environnement Canada
Canadian Wildlife Service/Service canadien de la faune
351 St. Joseph Boulevard • Gatineau, Quebec
Telephone 819-997-1095 • Fax 819-997-2756
Email cws-scf@ec.gc.ca

NOTE: These environmental assessment guidelines will be reviewed and updated when required as new information on the interactions between wind turbines and birds becomes available. The most up-to-date approved version is available on the Environment Canada website at http://www.cws-scf.ec.gc.ca/publications/eval/index_e.cfm.

This Guide is intended for educational purposes only. It should not be perceived as a substitute for the Canadian Environmental Assessment Act, the Species at Risk Act or any other federal legislation referred to in this Guide. In the event of any inconsistency between this Guide and the legislation, the latter would prevail. Individuals with specific legal problems are urged to seek legal advice.

This Guide refers to the environmental assessment of wind farms with respect to birds. The Federal Government of Canada has jurisdiction over migratory birds as defined in the Migratory Birds Convention Act and described in Article 1 of that Act. Other birds, including raptors, blackbirds and their allies, corvids, and some upland game birds are under the jurisdiction of the provinces and territories, as are mammals (including bats), plants, and most other forms of biological diversity. The guidelines in this document are usually relevant to all species of birds, and in some cases may be helpful for some other species (e.g. bats). Nevertheless, the other government agencies responsible for other groups of birds and other animals and plants should be contacted for EA advice specific to those groups.

The companion documents, “Wind Turbines and Birds: A Review”, and “Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds” are available for consultation at http://www.cws-scf.ec.gc.ca/publications/eval/index_e.cfm.

For questions or information, please contact the Canadian Wildlife Service of Environment Canada.

Acknowledgements

This guidance document was developed by Environment Canada based on work undertaken by Bird Studies Canada (Andrea Kingsley and Becky Whittam) under contract to Environment Canada. It builds on the review of available information on bird-wind turbine interactions from around the world (Kingsley and Whittam 2005, available at http://www.cws-scf.ec.gc.ca/publications/eval/index_e.cfm), as well as work by the same authors on a matrix approach to environmental assessment guidance.

Input and advice was provided throughout the work by scientists from the Canadian Wildlife Service (CWS), and environmental assessment (EA) practitioners at Environment Canada. In particular the Wind Power Working Group from the CWS, which includes representatives from all regions, provided extensive input and reviewed this document.

In the course of developing this work, comments were provided by industry (including the Canadian Wind Energy Association), other levels of government and environmental associations. Dr. Steve Percival provided guidance in the development of the matrix approach.

These guidelines are based on current science and best available information, but are subject to revision as new information becomes available. They will be reviewed and updated as required. Comments can be sent to:

Environment Canada / Environnement Canada
Canadian Wildlife Service/Service canadien de la faune
351 St. Joseph Boulevard • Gatineau, Quebec
Telephone 819-997-1095 • Fax 819-997-2756
Email cws-scf@ec.gc.ca

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Government of Canada is committed to reducing greenhouse gas emissions and is encouraging the establishment of alternative energy sources such as wind energy. As the wind energy sector rapidly expands, it is important to ensure that it does so in a manner that does not result in adverse effects on other aspects of the environment. Environmental assessment (EA) is a tool that provides an effective means of integrating environmental factors into planning and decision-making processes in a manner that minimizes adverse environmental impacts of development.

Wind energy projects have the potential to affect birds adversely through direct fatalities, disturbance, and habitat loss. The purpose of this document is to outline the nature of information needed in an environmental assessment to identify, assess, monitor and mitigate the potential adverse effects of wind energy projects on birds, especially migratory birds and species at risk. This is an essential component of any EA of wind energy projects.

This guide recognises the current uncertainty in predicting and understanding effects of turbines on birds, including inherent difficulties in assessing and monitoring bird-turbine collisions. It uses best available information to indicate the appropriate level of effort required to assess and monitor potential effects, given the sensitivity of relevant species and their habitats. This guide is intended to be used in consultation with regional Canadian Wildlife Service biologists and EA experts to consider site-specific concerns.

The guide can be used as a pre-assessment tool to identify site and design features that should be considered to minimise impacts on birds. The guide is also intended to be used as an EA guide, in conjunction with expert advice provided through Environment Canada on how to undertake that part of the EA that relates to birds. Guidance is provided on preliminary information necessary to determine site sensitivity. The guide uses a matrix approach based on site sensitivity and facility size to rank the proposed project into a project category that indicates the relative level of effort anticipated in determining and mitigating potential adverse effects to birds. Baseline information and follow-up requirements are identified for the four project categories. The guide also provides information on assessing cumulative effects.

1.0 INTRODUCTION

The Government of Canada ratified the Kyoto Protocol in 2002, and is committed to reducing greenhouse gas emissions and encouraging the establishment of alternative energy sources such as wind power. In 2001, Canada's Wind Power Production Incentive (WPPI[1]) was announced to encourage the growth of this green energy. Budget 2005 announced an expansion of WPPI to a level that would produce enough energy to power one million Canadian homes. Thus, wind energy is a fast-growing sector in Canada, as it is elsewhere in the world.

Wind power projects have the potential to adversely affect wildlife, particularly aerial wildlife such as birds and bats. Three main types of adverse effects on birds have been identified: direct fatalities, disturbance, and habitat loss (Kingsley and Whittam 2005). While the impact of individual projects may often be low, with the growth of the industry, the potential of wind energy production to adversely affect wildlife on a cumulative basis increases.

This guidance document has been developed for environmental assessment (EA) practitioners and proponents of wind energy projects in Canada. It identifies the types of information and assessments that Environment Canada (EC) would expect in a project-level EA to address the potential effects on birds. It also provides recommendations on site selection and design of wind energy installations so that factors that present the greatest risk to birds can be avoided upfront, early in the planning process.

This guidance document was developed following the completion of a companion background review of information available on bird-wind turbine interactions from around the world (Kingsley and Whittam 2005, available at http://www.cws-scf.ec.gc.ca/publications/eval/index_e.cfm). Input was also provided by Canadian Wildlife Service (CWS) scientists, Environment Canada environmental assessment (EA) practitioners, and members of the Canadian Wind Energy Association (CanWEA).

While we have an understanding of the factors that heighten risk to birds, there are still many uncertainties relating to the science and our ability to closely predict and understand the effects of turbines on birds, including inherent difficulties in assessing and monitoring bird-turbine collisions. The approach adopted in this guide recognises this uncertainty and builds on best available information to indicate the appropriate level of effort required to assess and monitor potential effects, given the sensitivity of relevant species and their habitats. Meanwhile, the CWS is fostering a collaborative research model with industry, universities and government to address priority issues and to establish greater certainty. As the knowledge gaps are filled, and as Canadian experience grows and the science and technology of assessment improves, this guide will be updated to reflect the improved understanding. As well as addressing broader national-level questions, the collaborative model provides an additional opportunity for wind power companies to form partnerships to address environmental issues and engage in adaptive management.

The approach recognises that site-specific concerns, such as local patterns of bird use or differences in habitat must be taken into account, and depending on these circumstances, the sampling effort may need to be adjusted. Therefore, these guidelines are intended to be used in consultation with regional CWS biologists and EA practitioners. This guide is intended for educational purposes only and should

not be regarded as exhaustive or restrictive -- it should serve as the starting point for discussions with Environment Canada staff on each project, whose advice may over-ride anything in this document.

1.1 Purpose

The purpose of this document is to outline the nature of information typically needed in an environmental assessment to identify, assess, mitigate and monitor the potential adverse effects of wind energy projects on birds, especially migratory birds and species at risk, in order to:

- Guide the wind farm industry to make the best possible choices on wind farm location, design, and operation to minimise the risks to birds and wildlife;
- Ensure that the Responsible Authority for any wind farm environmental assessment (as defined in the Canadian Environmental Assessment Act) is aware of and can consider the factors that present risks to birds in order to ensure that the best possible advice can be given and the optimal mitigation suggested;
- Guide the presentation of advice from Environment Canada on environmental assessments of wind farms;
- Specify the types and amount of baseline information that is required for the environmental assessment; and describe the likely extent of follow-up that would be necessary after construction.

1.2 Wind farm projects and federal environmental laws

Many bird populations in Canada and North America have been declining, especially over the past thirty years. Several species have lost half their numbers in only one human generation, and this rate of decline is of concern to scientists, naturalists and increasingly, to the general public. These declines are due to a number of factors, including loss and degradation of breeding and wintering habitats, impacts of chemicals such as pesticides, as well as collisions with tall structures (buildings, towers, power lines, etc.) on migration or while staging, wintering, or breeding.

Most birds that occur in Canada migrate between breeding and wintering areas. As the conservation of migratory birds is the joint responsibility of all countries they visit during the year, the Canadian government is a party to international efforts to protect migratory birds and their habitats.

The Migratory Birds Convention of 1916 between the USA and Canada is an international treaty implemented in Canada by the federal *Migratory Birds Convention Act, 1994* (MBCA) and accompanying regulations. The MBCA (section 5) prohibits any person to possess a migratory bird or nest, or buy, sell, exchange or give a migratory bird or nest or make it the subject of a commercial transaction except as authorized by the regulations. Therefore, permits are required for the handling of migratory birds or bird carcasses. The *Migratory Birds Regulations* (MBR), in Section 6, prohibit the disturbance, destruction, and taking of a nest or egg of a migratory bird; or the possession of a live migratory bird, or its carcass, skin, nest or egg, except under authority of a permit. It is important to

[1] A list of acronyms is presented in Appendix B

note that under the current MBR, no permits can be issued for the incidental take of migratory birds caused by development projects or other economic activities. Section 5.1 of the MBCA also prohibits the deposit of harmful substances to migratory birds in waters or an area frequented by migratory birds or in a place from which the substance may enter such waters or such an area anywhere in Canada and in Canada's maritime exclusive economic zone**.**

The *Species at Risk Act* (SARA) protects plants and animals listed in Schedule 1 of the Act (the List of Wildlife Species at Risk). The SARA also requires that every person required by federal law to ensure that an EA is conducted must (1) notify the competent minister(s) in the likelihood that a project will affect a listed wildlife species or its critical habitat; (2) identify the adverse effects of the project on the listed wildlife species and its critical habitat; and, if the project is carried out, (3) ensure that measures are taken to avoid or lessen the adverse effects and to monitor them. The measures must be taken in a way that is consistent with any applicable recovery strategies and action plans.

1.3 Wind farm projects and federal environmental assessment

The *Canadian Environmental Assessment Act* (CEAA) and its regulations are the principal legislative basis for federal involvement in environmental assessment. An EA under CEAA will be triggered when the federal government is the proponent of a project, grants an interest in land for the purpose of enabling the project to be carried out in whole or part, provides funds, or makes a regulatory decision that is prescribed on the Law List Regulations in respect of the project. A federal authority responsible for decisions with respect to a project that triggers the Act is legally required to ensure that the environmental effects of the proposed project are considered, that the significance of those effects is understood and that mitigation measures are identified and applied where required.

The most frequent CEAA trigger for wind farms is the provision of federal funds through the Wind Power Production Incentive Program. In such cases, Natural Resources Canada (NRCan) is the responsible authority for the federal environmental assessment. NRCan has developed overall guidance on the EA requirements for wind farms (excluding offshore projects); please consult the: "Environmental Impact Statement Guidelines for Screenings of Inland Wind Farms Under the *Canadian Environmental Assessment Act"* located at http://www.canren.gc.ca/programs/index.asp?CaId=190&PgId=1155.

As a Federal Authority under the *Canadian Environmental Assessment Act*, Environment Canada is called upon to provide advice to other federal departments on migratory birds, species at risk and their habitats, among other issues, for projects on private and public land. The EC regional EA offices are usually the first point of contact for EA information within the department; contact information is provided at http://www.ec.gc.ca/ea-ee/home/regions_e.asp.

This guide provides information needed to complete one aspect of the federal environmental assessment of a wind energy project: assessing the potential effects on migratory birds. Environment Canada Regional Environmental Assessment Coordinators may also request information or provide

advice on other issues such as potential adverse effects on sensitive habitats, non-avian wildlife species at risk, sensitive species such as bats, or other issues such as water quality.

While these guidelines provide advice that is relevant to all bird species, it is important to recognize that provinces and territories are responsible for some bird species (including raptors, blackbirds, non-migratory game birds), as well as mammals including bats, and other plant, insect and vertebrate animal species (see Appendix D), and their input may be needed in the environmental assessment. In addition, appropriate provincial or territorial environmental assessment guidelines may also apply. In some cases, a harmonised EA process may be developed combining all requirements.

Note also that the scope of the project will be defined according to federal guidelines, and impacts resulting from other facilities, such as access roads and transmission lines, may also need to be addressed.

2.0 HOW TO USE THIS GUIDANCE DOCUMENT

This guide should be used in two contexts:

1. ***As a pre-assessment tool.*** Early in the project planning process, the guide should be used by proponents to alert themselves to important siting considerations, lighting options and basic project characteristics that can affect the risk to birds. Further details are in the companion document: "Wind Turbines and Birds: A Review" available at http://www.cws-scf.ec.gc.ca/publications/eval/index_e.cfm. Avoidance of features that lead to higher potential risk at this stage will reduce the subsequent level of effort required in the environmental assessment. Proponents are strongly encouraged to consult the regional CWS or EA office for further information and guidance in identifying, assessing and mitigating these risks.

2. ***As an EA tool.*** The guide is intended to be used in conjunction with expert advice provided through Environment Canada.

    - Under CEAA, the federal authority responsible for the EA (the Responsible Authority, or RA) makes a decision on the adequacy of the federal EA, determines the likely significance of potential adverse environmental effects, and specifies the amount and type of follow-up, if necessary. Federal expert authorities provide advice and expertise throughout the process. The RA issues direction on how to carry out the screening which is then undertaken by the proponent.

    - In the context of a federal EA, this document provides generic guidance on how to undertake that part of the EA that relates to birds. It provides information on how to determine the sensitivity of the site to birds, the baseline information required for the analysis of potential adverse effects, the identification of mitigation for these effects, and follow-up requirements.

    - While the guide provides a picture of the "typical" situation, it cannot cover all regional or local case-specific circumstances. The guide was developed to achieve a balance between clarity of requirements and the flexibility that is necessary to adapt to these very

important site-specific considerations. For this reason, the guide is intended to be used with input from EC experts.

- The guide provides information on assessing cumulative effects, as required under CEAA. Assessing cumulative effects involves considering cumulative impacts at a site (e.g., increase in numbers of turbines as well as access roads and transmission lines) and at a region level (many sites). Broader-scale regional assessments must also consider the cumulative impacts of all developments, not just those of wind energy development. This goes beyond the scope of this guide, but will be considered by EC experts being consulted on the project.

- In situations where follow-up is required, the EA should include the use of a protocol for determining the actual effects of a project following implementation. This guide provides generic direction on what may be required in such a follow-up protocol. Again, consultation of regional CWS experts is recommended.

2.1 Organisation of the guide

This guide is organised into sections that reflect each step in the recommended approach.

- **Step 1: Pre-assessment considerations** (Section 3). Before committing to a specific site or design, a quick check should be undertaken to see if the proposed site or design contains any features that are identified in this section as potentially important to birds and sensitive to disturbance.

- **Step 2: Preliminary information required** (Section 4). This is primarily a desktop exercise to collect preliminary or available data about the site in order to determine its likely sensitivity. Collect preliminary data through literature, existing unpublished studies, or broadly available data bases, in some cases supplemented by reconnaissance field surveys, to determine the bird populations and habitats that may be affected by the development. In most cases, knowledge of the habitat that will be affected, and the geographic location, can be used to determine what bird species are likely to be using the area and the types of surveys that are likely to be required. A default category level can be assigned where existing information is unavailable or insufficient.

- **Step 3: Determination of site sensitivity** (Section 5). Preliminary information is then used to determine a site sensitivity rank as outlined in Table 1.

- **Step 4: Size of the facility** (Section 6). The proposed size of the facility and the cumulative number of turbines in the area are used to determine the project's size ranking from Table 2.

- **Step 5: Determining the project level of concern category** (Section 7). A matrix based on site sensitivity and facility size is used to classify the project within one of four categories. The predominant issue for determining the project level of concern category is the site sensitivity; however, size of the proposed wind farm is also factored into the analysis although given less weight. When combined, these features indicate the relative level of concern to birds. The higher the category, the higher the relative level of effort likely to be needed for the analysis of potential impacts on birds.

- **Step 6: Determining the level of baseline information needed** (Section 8). The project level of concern category guides the extent of baseline information required, by identifying general questions that must be addressed for each category. Site-specific adjustments are likely to be required in consultation with EC.

- **Step 7: General considerations relating to facility or site design** (Section 9). The answers to the baseline questions can assist in determining the potential environmental effects of the proposed project, and can be applied directly to modify the design and layout of the wind farm to reduce impacts on birds.

- **Step 8: Verifying predictions and mitigation effectiveness** (Section 10). The project level of concern category may be adjusted following the analysis of baseline information, and will then guide the extent of follow-up that is needed to determine actual environmental effects of the project. In some cases, this information may suggest mitigation measures that are required, and it will also contribute to cumulative impact assessment that may influence future projects.

2.2 Process overview

As discussed in section 1.3, this guide focuses on one aspect of the federal EA requirements: the analysis relating to potential effects on birds.

In nearly all cases baseline information will be required on the numbers and species of birds actually using the proposed area. Because bird activity changes throughout the year, data must be collected at the appropriate time of year, in most cases during several seasons. Nearly all sites will require data on breeding birds using the area, which usually requires surveys in May or June. Sites in areas likely to be in migration corridors may also require surveys during the spring (March – May) and/or autumn (August – November) migration, while some areas may require winter surveys (November – April). Thus, it is important that planning to collect baseline data commence at least one year in advance of any planned construction. A proponent may choose to collect the baseline information early in the planning process, before the EA is triggered, to avoid delays later when timelines may be more critical. For these reasons, Environment Canada encourages early consultations whether or not an EA has been triggered. Early consultations can include informal discussions or meetings.

Gathering the information needed for an EA is the responsibility of the proponent, and collecting information on birds is no exception. Environment Canada can provide guidance to the proponent on the information required, but will not carry out the actual data collections or analyses. As an expert federal authority, EC will also provide advice to the Responsible Authority which can include comments on the accuracy and consistency of information provided, the adequacy of proposed follow-up, and recommendations for adaptive management.

The key steps of the EA process and the required analyses for birds, in relation to the planning of a typical wind farm, are outlined in Figure 1. Figure 2 provides an overview of the process outlines in this guide to obtain and incorporate information on birds into an EA.

Figure 1: Key steps of the EA process and the required analyses for birds, in relation to the planning of a typical wind farm

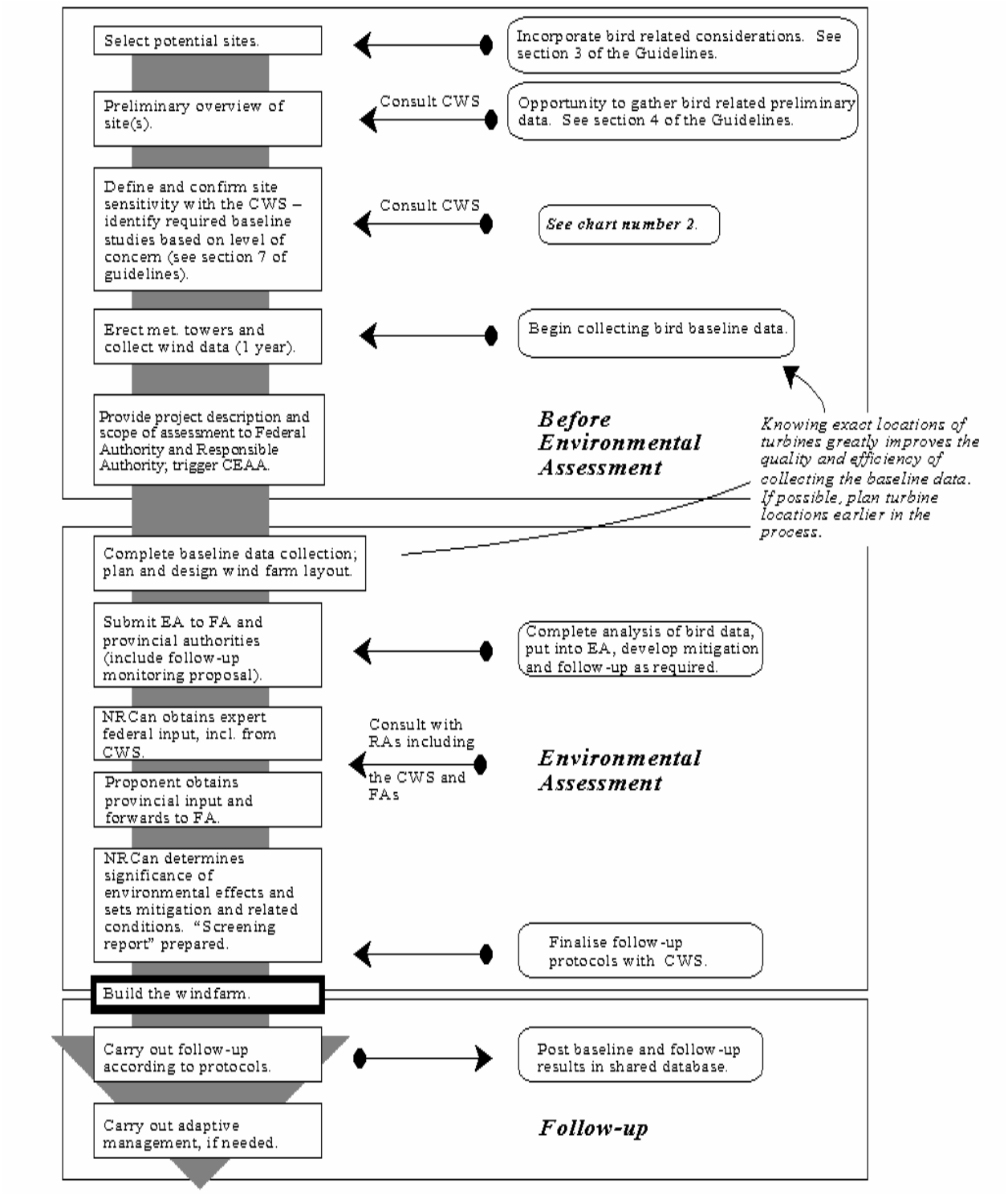
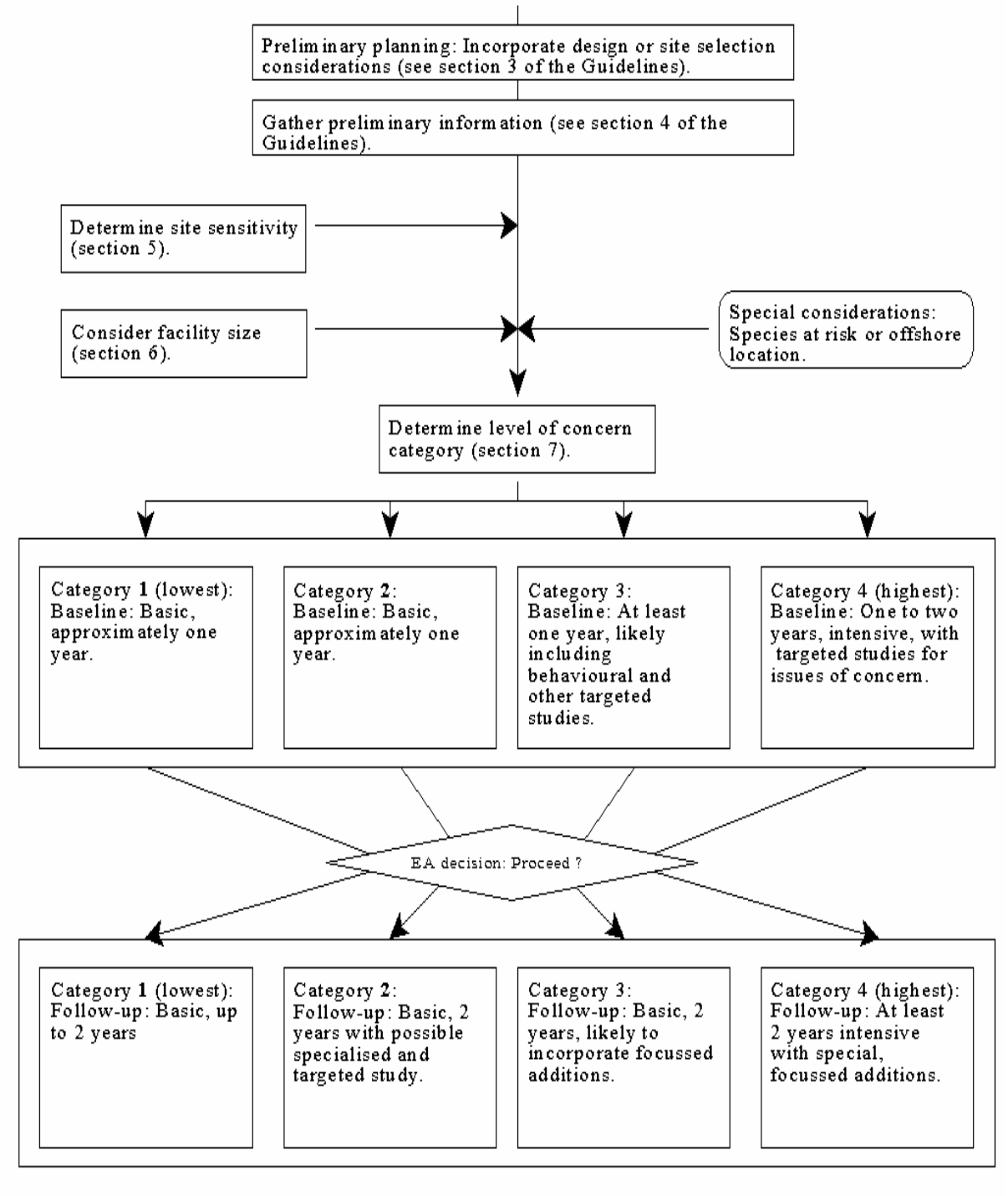


Figure 2: Overview of the process outlines in this guide to obtain and incorporate information on birds into an environmental assessment.



3.0 SITE SELECTION AND DESIGN CONSIDERATIONS

The risk of negative consequences to birds from turbines can be reduced through careful site selection and facility design. The following considerations have been prepared based on best available information to assist the proponent in making such choices early in the planning process (see background review in companion document for more information). In addition to reducing the potential for adverse environmental effects, this approach can reduce the amount of work required for the environmental assessment.

3.1 Site selection considerations

The proponent should consult Table 1 and examine the factors that determine whether a site has a higher level of concern or whether it may entail special considerations. If the site has these factors, the proponent may wish to choose another site that presents less risk to birds, prior to initiating the environmental assessment.

Proponents may also wish to consider the relative suitability of different locations for a given facility, early in the planning process. By comparing different sites, based on the presence or absence of features identified in Table 1, the site presenting the least risk to birds may be selected and the ensuing environmental assessment may then be simplified.

3.2 Facility design factors and operations that affect risk to birds

The following factors and operations are known, or presumed from the best available science, to affect a wind energy installation's risk to birds:

- Number of turbines: Simply put, more turbines intercept more air and displace more habitat than fewer turbines, but a smaller number of larger turbines may pose less of a risk to birds than a larger number of smaller turbines.

- Wind farm configuration: Compact clusters of turbines remove the least habitat and present a minimal barrier to bird movement where directionality of movement is either random or not predictable. Linear configurations can intercept the most numbers of moving birds when the normal direction of movement is orthogonal to their placement, or the least when movement of birds is along the string of turbines. Linear placements that separate birds from their daily roosting, feeding or nesting sites also pose a greater threat because they have to be crossed frequently. The optimal configuration of turbines depends on the location and can be chosen to present the least risk to birds. For example, European experience has led to the recommendation that strings of turbines in coastal areas be avoided because they cause very extensive disruption of bird movements.

- Relative height and elevation of turbines: Generally, objects over 150m in height appear to pose a greater threat to nocturnal migrants; such taller objects can cause mass bird kills, as found at communication towers and tall buildings. Any turbines taller than 150m in height should be

subject to closer scrutiny to ensure their environmental impact is minimised, especially for sites close to arrival and departure sites of nocturnal migrants, on mountain tops or in foggy areas. However, even shorter turbines may pose a risk depending on their location and elevation (such as hill tops, ridgelines, or proximity to arrival or departure sites of nocturnal migrants).

- Guy wires: Guyed structures are known to pose a greater risk to birds, especially if also lighted for aviation safety or other reasons. Meteorological towers associated with wind farms therefore also pose an increased threat to birds if they are guyed.

- Lights: The number, location and types of lights can have an important effect on the probability of nocturnal migrants being attracted to and killed at wind turbines. Lighting should only be used where required by Transport Canada regulations. Use lights with short flash durations and the ability to emit no light during the "off phase" of the flash (strobes and modern LED lights are capable of this), with the minimum number of flashes per minute (*i.e.*, longest pause between flashes) and the briefest flash duration allowable. Steady-burning or other bright lights such as sodium vapour or spotlights on turbines and other structures have been shown to attract birds which would make them vulnerable to being killed or injured.

- Motion smear: Birds do not recognise the threat posed by a quickly turning blade and cannot learn to avoid them. Even larger turbines that have lower hub rpms have tip and blade speeds that are fast enough to prevent birds recognising the threat they pose.

- Transmission lines. Overhead transmission lines, particularly in sensitive habitat, can disrupt birds' daily movements or threaten them with the risk of collision. Overhead lines are also associated with extensive removal of habitat and involve extended control measures to keep the vegetation from growing back. In areas where the risk of bird collision is low, and where sensitive habitat exists, the placement of wires underground may cause more damage to local bird populations through habitat destruction than overhead wires would cause through collisions. Each site should be examined individually to assess the best solution. In some areas where burying the wires is impractical (*e.g.,* areas of shallow bedrock), the mitigation techniques presented by the Avian Power Line Intervention Committee (1994, 1996) should be considered. Examples are:

    - Line visibility should be increased by bird flappers or other bird flight diverters, and, where possible/feasible, increasing the size of the wire (to larger than 230kV).
    - Lines should not be built over water or other areas of high bird concentrations.
    - Small lightning shield wires should be eliminated where lines cross wetlands and migration routes.
    - Lines should be placed as close to trees as is practical and below the level of tree tops wherever possible.
    - To prevent the electrocution of large birds such as raptors and cranes, lines should be designed with adequate space between conductors to prevent a bird from simultaneously touching two phases.

- Ancillary habitat loss: Habitat loss is associated with the footprint of the turbines themselves, the associated road network, and the placement of power lines. Generally, roads and power lines

lead to much greater habitat loss than the towers themselves. This loss can be minimized through use of underground lines, whenever possible, and by constraint mapping to assess where roads should or should not be located. Habitat destruction, habitat fragmentation and disturbance of breeding, staging and wintering birds should be minimised as much as possible Access roads that are not used after construction should be allowed to re-vegetate, or should be replanted or reseeded. In natural settings, the habitat around the site should be maintained as close as possible to what occurred there before construction. Any seeding or planting should use plants native to the specific area only.

- Attraction of the site to birds: Sites near water in an otherwise dry area, near large food sources, etc. may pose a greater threat because these features concentrate birds.

- Industrial and other waste: Oil drums and cans, lubrication tubes, crates, packing material, plastic containers and bags left on-site are pollution and can have a severe impact on the environment including the birds that use the area. They must be disposed of properly and not left at the site unless a permit has been given to dump such materials on-site. Care must be taken that machines are well maintained and do not leak excessive amounts of oil or lubricating fluids from the nacelle or blades. Waste oil could directly impact birds, or could cause broader environmental damage, especially if it leaches into wetland systems.

- Decommissioning: Any turbines left standing that are no longer needed to produce power present an unnecessary risk to birds, especially if they remain lighted for aircraft safety. Adopt a decommissioning plan that would require removal of the turbines and infrastructure when the facility is no longer operational, including restoration of the site to approximate pre-project conditions. The turbine platforms should be removed (when appropriate) to a reasonable depth and soil replaced over any remaining concrete. If the site was formerly a natural area, all roads and any other disturbed area should be re-vegetated using native vegetation or standard seed mixes (the use of invasive species must be avoided) to help the site return to its original state as quickly as possible.

4.0 GATHERING PRELIMINARY INFORMATION

Preliminary information must be gathered by the proponent or its consultants for all sites, regardless of size, prior to construction. This preliminary information is needed to determine site sensitivity, and hence the level of concern category for the project, as well as to flag any features that could require further investigation or special focus when field surveys are undertaken.

This step is intended to be primarily a desktop exercise collected through literature, existing unpublished studies, or broadly available data bases to determine the bird populations and habitats that may be affected by the development. In most cases, knowledge of the habitat that will be affected and the geographic location can be used to determine what bird species are likely to be using the area and the types of surveys that are likely to be required.

Section 4.1 outlines a list of basic questions that should be answered by gathering this preliminary information. Section 4. 2 outlines methods of answering these questions.

Gathering preliminary information does not constitute an additional study requirement but instead represents a step in the planning process before collecting baseline information. In addition to providing the foundation for determining site sensitivity, preliminary information can be used to plan pre-construction monitoring more efficiently, and hence minimize costs of the overall assessment process.

When there is little available information to determine site sensitivity, the project will be assigned a category 3 level of concern. In keeping with the precautionary principle, category 3 assumes that the site could contain some features of high sensitivity. In this case, moderately extensive field work may be required to obtain baseline information, and to determine what factors are, in fact, of greatest concern. Should the baseline data find factors of particular concern, then additional data may be required to identify appropriate mitigating factors; conversely, if the baseline data indicate no major concerns, then the category can be adjusted downwards.

4.1 Preliminary questions to consider

Part of determining a site's suitability for wind turbines includes gathering existing information on what birds are present, or likely to be present, and whether there are any potential features or species that would increase the site's sensitivity.

Preliminary studies should gather as much information as possible to answer the following questions. Note, however, that it is not expected that answers will be available to all of these questions at this stage. Planning for subsequent baseline surveys will be designed to fill gaps

Birds

Which species:

- breed, migrate through, or winter at the site and in the surrounding area, and what is their relative abundance? Make special mention of:
    - any species at risk, including species listed under the *Species at Risk Act* (SARA), provincially or territorially designated species, species designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), or species designated as priority species by the Conservation Data Centres (CDC), Partners in Flight (PIF) or the CWS;
    - bird colonies (note species, size, location);
    - raptors or shorebird concentrations; and
    - species that have aerial flight displays.
- congregate at significant migration staging areas at or near the site?;
- commute (e.g., between breeding and foraging habitats) in significant numbers through or near the area?

Habitat

- What habitat types occur on the site and in the surrounding area?
- Do these habitats typically support habitat-sensitive or habitat specialist species, *e.g.,* forest-interior species, grassland species, or shrubland species?
- What is the relative density of breeding birds in these habitats?
- What breeding or migrating birds do these habitats typically support?
- How much of each habitat type or function will be lost or altered as a result of this development?

- What topographical features that may influence bird activity and movement, such as islands, peninsulas, and ridges, are located on or near the site?

Human use

- What is the expected amount and type of human presence (vehicles, pedestrians, tourism, etc.) at the site at different times of the year, during and following construction?

Meteorological data

- What meteorological data are available from the site (in addition to wind speed and direction which are of obvious importance for assessing the economic value of wind turbines) that may affect bird mortality risks, such as numbers of days with fog or low visibility (*e.g.,* horizontal visibility <200m or cloud bases <200m) for the site, particularly at times when birds may be using the area?

4.2 Sources of Preliminary Information

Many of the above questions can be answered through literature searches and consultation with appropriate natural resource agencies, environmental non-government organisations, or through local ecological knowledge such as the observations and knowledge of local bird experts, ornithological clubs, naturalists and conservation organisations, and local landowners.

Information may be obtained from the following sources (see Appendix A for website information):

- Appropriate government agencies: Consult the local office of the Canadian Wildlife Service of Environment Canada, and provincial or territorial natural resource and wildlife departments, to identify key species that may be of concern in the area, and for other relevant sources of information on these birds.

- Conservation Data Centres (CDC): Also sometimes known as Natural Heritage Information Centres (NHICs), CDCs are an important source of information on locations where provincial and federal species at risk, and other species of regional conservation concern, have been identified.

- Species at risk (SAR) websites: Check the federal, provincial and territorial species at risk websites to determine whether there may be any listed species, residences of individuals of those species, or critical habitat that occur within the general area. The federal SARA Public Registry will also provide information on critical habitat, residences and other available information (including the updated SARA List)[2]. The COSEWIC site identifies species that have been assessed by that committee that may or may not have been listed under SARA. Most web sites do not provide exact location information. When in doubt, contact appropriate federal or provincial/territorial agencies.

- Pre-existing survey information: This may include surveys conducted annually by local naturalists or naturalist groups, and various volunteer-based bird monitoring surveys such as provincial

breeding bird atlases, Audubon/Bird Studies Canada Christmas Bird Counts, the Breeding Bird Surveys, and regional owl, raptor, woodpecker and other avian survey programs.

- Migratory Bird Sanctuaries/National Wildlife Areas: Check to determine whether the site is in close proximity to a Migratory Bird Sanctuary (MBS) or National Wildlife Area (NWA). If so, the relevant websites will contain information on the significant species or features found there.

- Bird Conservation Region (BCR) plans: These are being developed across Canada as part of the North American Bird Conservation Initiative (NABCI). BCR plans identify species, or suites of species, along with their habitats that are conservation priorities for each region. Consult the Canadian Wildlife Service to obtain information on a specific region's BCR plan.

- Existing environmental assessments: Consult other environmental assessments or any similar documents that may be on the public record for the site in question, or for adjacent sites. Also, consult EAs for similar-sized projects in the same or nearby jurisdictions.

- General Status of Species in Canada website: Consult this website to determine if any of the species known to be at the site from the above surveys are ranked 1 (At Risk), 2 (May Be at Risk) or 3 (Sensitive), either nationally or provincially. See http://www.wildspecies.ca/.

- Important Bird Areas website: Check this website to see whether the project site is near or within an Important Bird Area. If so, this website will contain information on the significant species found there (http://www.ibacanada.com/).

- Scientific and natural history publications: These include refereed journals (*e.g.,* Canadian Field Naturalist), non-refereed publications (*e.g.,* Nova Scotia Birds), and provincial natural history databases (which may include the archives of natural history e-mail list serves).

It is anticipated that in most cases, sufficient data can be obtained from literature surveys, together with basic information on the habitats and geography of the site, to determine the site sensitivity and plan appropriate baseline surveys. However, if very little information exists, it may be worthwhile to hire an expert bird biologist, familiar with the birds and habitats of the region, to assess the area through a reconnaissance visit. At this stage, a relatively short visit, focussed on habitat assessment and identification of major geographical features should be sufficient to help determine site sensitivity and to assist with planning the more intensive baseline surveys. In some cases, information available for similar or nearby sites, such as information on habitat or bird distribution, may be pertinent.

5.0 DETERMINING SITE SENSITIVITY

Information gathered in Sections 3 and 4 should now be compared with Table 1 to determine the sensitivity of this site from the perspective of bird use. Table 1 identifies factors that could increase the risk of adverse effects on birds. While some of these factors are clearly defined (such as National Wildlife Areas or Migratory Bird Sanctuaries which have boundaries established by regulations),

[2] Please note that provisions of SARA may apply where listed species, the residences of individuals of those species, or critical habitat, may be affected by the project. For more information, or for definitions of SARA terms, please consult Appendix C.

others, such as "important" bird colonies are less specific. "Generic" qualifiers are needed to provide the flexibility to take regional or species-specific considerations into account. Thus, the determination of site sensitivity should be undertaken in consultation with a regional CWS specialist (see Annex A) who can help to take into account local and regional information. In addition, examples are provided in the text boxes as well as in Appendix C to illustrate how these concepts are being interpreted.

The presence of any one factor identified in each category will result in a sensitivity rating within that category. In the case of uncertainty over a particular feature, a precautionary approach is recommended. If there is insufficient information to determine the appropriate category, the project should be placed in a Category 3 level of concern, usually associated with a "high" site sensitivity rating. Baseline information protocols will then be directed to the collection of missing information to adequately assess potential effects of the project.

Where a listed species at risk, a residence of individuals of that species, or critical habitat is identified at the site, special considerations apply, including provisions of the *Species at Risk Act.* Consult the regional CWS office prior to continuing with any aspect of the project in such cases. For more information see section 8.6. Note that while the site sensitivity table considers factors relating to birds, the presence of any wildlife species at risk will require special consideration.

Any proposal for offshore developments also requires special consideration, because of the limited information available on possible interactions between birds and wind turbines offshore. Again, consult the regional EC experts for more information.

Note that this table considers only risks associated with birds. In some cases, other wildlife may be a greater concern. For example, bats have been shown to be particularly vulnerable to wind turbines. If a proposed site is near known concentrations of bats, then appropriate provincial officials should be consulted to determine necessary next steps.

Table 1. Site sensitivity

Potential Sensitivity	Determining factor
Very high	• The presence of a bird species listed as "at risk" by the SARA, COSEWIC or provincial/territorial threat ranking, or the presence of the residence(s) of individuals of that species if listed under the SARA, or of its critical habitat. To be of concern, either the bird or its residence or critical habitat must be considered to be affected by the project. • Site contains, or is adjacent to, a large or important bird colony, such as herons, gulls, terns and seabirds. • Site contains significant staging or wintering area for waterfowl or shorebirds, or significant areas of bird concentrations. • Site is in, or is adjacent to, an area recognised as nationally important for birds (*e.g.,* by being located in or adjacent to a National Wildlife Area, Migratory Bird Sanctuary, Important Bird Area, National Park, Western Hemisphere Shorebird Reserve Network (WHSRN) site, or similar area specifically designated to

	protect birds). • Site contains large concentrations of raptors. • Site is on a known migration corridor.
High	• Site contains one or more landform factors that concentrate birds (*e.g.,* islands, shoreline, ridge, peninsula or other landform that may funnel bird movement) or significantly increase the relative height of the turbines. • Project will disrupt large contiguous wetland or forest habitat that may be of importance to birds. • Site is located between habitats where large local bird movements occur, or is close to significant migration staging or wintering area for waterfowl or shorebirds. • Site contains, or is adjacent to, a small colony of colonial birds, such as herons, gulls, terns, or seabirds. • Site is subject to increased bird activity from the presence of a large heron, gull, tern or seabird colony located in the vicinity of the site. • Site is subject to increased bird activity from the presence of an area recognised as nationally important for birds (*e.g.,* a National Wildlife Area, Migratory Bird Sanctuary, Important Bird Area, National Park, or similar area protected provincially or territorially because of its importance to birds). • Site contains species of high conservation concern (*e.g.,* birds known to have aerial flight displays, PIF/CWS priority species, etc.).
Medium	• Site is recognised as regionally or locally important to birds, or contains regionally significant habitat types.
Low	• Site does not contain any of the elements listed above.
Special considerations required	• Presence of a SARA listed species (not just birds) or the residence(s) or critical habitat for a SARA listed species that might be affected by the project.[3] • Proposed project is located offshore.[4]

Examples of site sensitivity determination:

A medium-sized windfarm is proposed for a location 4 km away from the largest colony of Roseate Terns in Canada. This colony supports 60% of the Canadian population of this SARA-listed, endangered species. The windfarm is adjacent to two small islands that are used as feeding sites by these birds; hence, the area experiences a high level of use by the Roseate Terns and questions were raised regarding possible adverse effects on the birds. For this reasons the site sensitivity was ranked as "very high" and the project required a "category 4" level of concern.

A windfarm is proposed in an area where a local naturalist group recorded a single sighting of a SARA-listed species over ten years previously. The observation was clearly an accidental occurrence and the

species was not observed in the area since then. The single record did not result in a very high sensitivity ranking for the area.

A proposed windfarm is to be located on agricultural lands in an area where Bobolinks and Horned Larks are found. Both these grassland bird species have aerial flight displays. Although normally this would rate a "high" site sensitivity ranking, site-specific considerations needed to be taken into account. The population density of Horned Lark in the area was not considered sufficient to lead to significant problems, and the Bobolink flight displays were considered to be generally too low to create a high risk from turbines. As a result the site sensitivity was ranked "low".

A proposed windfarm is located 14 km from a nationally important seabird ecological reserve. Among the many species nesting there, this site constitutes the largest colony of Leach's Storm-petrels in the world, where over 1 million Storm-petrels can be found for part of the year. Concern was raised over the birds' well-documented attraction to light, since they have been known to travel over 20 km to light sources such as oil production platforms. Therefore, it was determined that the site could be subject to increased bird activity from the presence of an area of national importance to birds; and if there were to be negative effects, the size of the colony meant that the consequences could be severe. As a result the site was ranked as "high" sensitivity".

6.0 SIZE OF THE FACILITY

The proposed facility should be assigned a size category based on the total number of turbines proposed, using Table 2. The assessment should include any existing turbines (*i.e.*, if the project is the expansion of an existing facility) as well as other turbines (*i.e.*, from other wind farms) within 1 km of the site. This is phrased "total local area projected to contain …" in the table below.

Incorporating the size of the overall facility into the analysis is important because, while larger facilities do not necessarily result in an increased number of per-turbine fatalities, the potential impacts from disturbance, habitat loss and possible barriers to bird movement are greater, as is the anticipated total number of fatalities.

Table 2. Facility Size.

Size	Definition
very large	Total local area projected to contain more than 100 turbines
Large	Total local area projected to contain 41- 100 turbines
medium	Total local area projected to contain 11-40 turbines
Small	Total local area projected to contain 1-10 turbines

[3] See section 8.4 for special considerations relating to species at risk.
[4] See sections 8.5 for special considerations relating to offshore projects.

Note that the above table only considers number of turbines and does not incorporate other design features, such as the type of lighting used, tower structure, placement of turbines, size of turbines, and so on. While such design considerations are certainly relevant to the overall risk to birds, it is very difficult to assign a generic value to each. However, such features should be taken into consideration when incorporating site-specific considerations into the approach for gathering baseline information and follow-up requirements.

7.0 DETERMINING THE LEVEL OF CONCERN CATEGORY

Use the matrix provided in Table 3 to determine the overall level of concern category associated with the proposed development.

The matrix matches the sensitivity of the site (as determined in Table 1) and the size of the proposed facility (as determined in Table 2) to rank projects into one of four possible categories. Generic guidance is then provided on the nature and extent of baseline information and follow-up requirements for each category. The "level of concern" is therefore relative to other wind energy projects and does not reflect the threat to birds posed by wind energy in comparison to other types of projects.

Note that Table 3 does not apply to offshore projects – see Section 8.6 for more information on such projects.

Table 3. Level of Concern Category Matrix

FACILITY SIZE	SITE SENSITIVITY			
	Very High	**High**	**Medium**	**Low**
Very Large	Category 4	Category 4	Category 3	Category 2
Large	Category 4	Category 3	Category 2	Category 2
Medium	Category 4	Category 3	Category 2	Category 1
Small	Category 4	Category 2	Category 1	Category 1

A windfarm is proposed in an area of low site sensitivity but the project itself will involve the construction of over 100 turbines in an area where other turbines have already been built. Since the project is considered "very large", the project category ranking is "2".

A windfarm is proposed for an area of very high site sensitivity. Even if the windfarm has only a few turbines, the category ranking will be 4 to reflect the need to address the sensitivity features.

Note: These categories describe the general level of risk to birds as compared with each other, not with other types of development, industrial or otherwise.

Category 1. Projects in this category represent the lowest level of potential risk to birds. Usually, such projects would require some basic surveys before construction to assess bird populations within the proposed area for the turbines, and to confirm that there are not any sensitive factors that were previously overlooked. However, it is important to recognize that even basic surveys must usually be conducted over a one year period, to ensure they are done at the appropriate time of year for each

species. Depending on the numbers of birds detected, some follow-up surveys may be required to assess impacts, but these would likely be minimal. Most likely, these would involve some surveys for short periods in each of 1 or 2 years post-construction, possibly starting one year after construction. In cases where little or no habitat would be impacted (e.g., wind turbines within an industrial park), few if any bird surveys may be required. Some carcass searching will be required to rule out unexpected mass mortality events.

Category 2. Projects in this category present a moderate level of potential risk to birds, and would require basic surveys, usually spread over a one year period, to obtain quantitative information on birds using the site and to identify any potential mitigation measures to minimize damage to bird habitat during construction. Post-construction follow-up surveys, spread over at least two years would likely be required to determine changes in bird use of the area associated with construction of the turbines. These follow-up surveys may not need to commence until one year after construction is completed. Some carcass searching will be required to rule out unexpected mass mortality events.

Category 3. Projects in this category present an elevated level of potential risk to birds, and require comprehensive surveys to gather baseline information. These will normally need to be done over the course of one calendar year unless additional concerns are identified in the process (e.g., an unexpected species at risk is found to be present) which could extend the time period. Pre-construction surveys need to quantify what species are using the area and obtain measures of their relative abundance. If the site contains concentrations of birds, or species thought to be particularly vulnerable to colliding with turbines, then observation studies may be required to determine the behaviour of these birds (e.g., to determine their usual travel routes, to determine if they might intercept proposed turbine sites). Such information may help to inform placement of turbines, or to determine the need for other mitigation measures. Post-construction follow-up surveys, spread over at least two years would likely be required to determine changes in bird use of the area associated with construction of the turbines. Regular carcass searching will normally be required to monitor the impact to breeding and migrating birds.

Category 4. Projects in this category present a relatively high level of potential risk to birds, and consequently are likely to require the highest level of effort for the environmental assessment. As with category 3 projects, relatively comprehensive baseline surveys will usually be required. In many cases, these can still be completed over the course of one calendar year, unless there are specific factors that require more intensive survey (e.g., if there is a major concern over a species that shows considerable annual variation in abundance), in which case an additional year of pre-construction assessment may be required. For this reason, proponents are strongly encouraged to design and initiate baseline surveys as far in advance as possible, so that delays in data gathering do not affect EA approval of the project. Depending on the findings of baseline studies, project proponents whose projects fall into this category may be encouraged or even required to seek alternative locations if significant adverse effects on birds are anticipated[5]. If the project does proceed, relatively detailed follow-up is likely to be required. Post-construction follow-up surveys, spread over at least two years and sometimes more, would likely be required to determine changes in bird use of the area associated with construction of the turbines.

~~24~~
24
24
24

[5] The environmental assessment will need to determine the likely significance of adverse effects, including effects on birds. Projects in this level of concern are more likely to lead to significant effects on birds, which is why proponents are

Carcass searching around turbines over at least 2 years is likely to be required during seasons when there is an elevated collision risk (e.g., when concentrations of birds are present, or during the migration season). Data gathering for more than two years would normally be targeted to answering very specific questions or concerns, and should in most cases only require limited work in the later years.

8.0 DETERMINING THE TYPE AND AMOUNT OF BASELINE INFORMATION REQUIRED

Baseline field data collected at the site are required for several purposes:
- to validate the initial determination of site sensitivity from the preliminary assessment;
- to understand the ways that birds use the site, to evaluate the extent to which they might be at risk from turbines;
- to identify any potential mitigation measures, such as changes in proposed placement of turbines that could reduce risk;
- to quantify the number and types of birds using the site so that, if construction proceeds, there are baseline data against which any changes in the bird populations can be compared;

The amount and type of baseline surveys required will depend on many factors, including the Level of Concern category of the project (as described in section 7.0), the nature of the particular factors that led to this classification, and the amount of data already available for the site from the preliminary assessment.

Given the importance of site-specific considerations, the proponent should work closely with regional CWS experts to develop an appropriate approach to gather this baseline information. In some cases, geophysical conditions at the site (*e.g.,* ridges, valleys, peninsulas, or other topographical features) may require special considerations that could warrant, for example, more frequent site visits or specialised surveys such as radar work. If a breeding colony is located near or on the site, the size of the colony and the species present would strongly influence the types of surveys required. Finally, specific considerations may arise from the design of the facility itself.

If the baseline surveys reveal that certain features are present at the site that were not initially identified in the preliminary information stage, the site sensitivity may need to be re-considered and the level of concern category may require adjusting.

Note that proponents should not undertake surveys within bird colonies or known breeding areas for certain bird species at risk, such as Piping Plover, as they are particularly susceptible to human disturbance. For advice in these cases, contact the CWS prior to undertaking field work. Should new colonies or breeding areas of species at risk be discovered while conducting field work, the CWS should be contacted immediately and the relevant information sent to appropriate federal and provincial natural resource agencies and to the appropriate regional or provincial local Conservation Data Centres

---

encouraged to consider other locations. At a screening level, the RA must determine whether the project, taking mitigation into account, is likely to lead to significant adverse effects, in which case it can either be abandoned or must be referred to a panel or mediation. The RA can exercise a duty or perform a function that will allow the project to proceed only if the screening determines that the project is unlikely to cause significant adverse environmental effects.

or National Heritage Information Centres (NHIC). See Section 8.3 for special considerations for species at risk.

8.1 Basic information required for most projects

This section outlines the types of survey information that would be expected for most projects, along with a brief outline of the survey techniques required. The CWS has developed a companion document "Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds" that provides detailed protocols for a number of different monitoring techniques. Whenever possible, monitoring should be undertaken using one of those recommended techniques, so that data from multiple sites can be pooled to enhance our understanding of the impacts of turbines on birds. A centralized data base is being developed to store data related to evaluating the impacts of birds on wind turbines. All proponents are strongly encouraged to make their field data available for storage in this centralized data base (such data will not normally be required until after construction of turbines has proceeded). Especially when combined with post-construction monitoring data using comparable approaches, this will allow CWS scientists to analyse the results more readily, thus enhancing understanding of the impacts of wind turbines on birds across Canada, and improving predictions of impacts of new wind turbine developments.

***Species Lists*:**
Surveys should be undertaken to determine what species are using the area at different times of year. This information serves to support and/or supplement the species lists determined or inferred from the preliminary assessment, and to identify whether any additional species may be of particular concern in the area.

***Habitat Impacts*:**
If the site contains habitat of potential value for birds, how much and what types of this habitat would be directly impacted by construction? Are there other types of habitat in the site that may be of lesser value to birds that could serve as alternative locations for turbines? In most cases, a habitat map should be prepared that shows the extent of all natural habitats in the area, with an overlay that shows how these are likely to be impacted by construction.

***Quantifying Breeding Bird Numbers*:**
If the site has breeding populations of native bird species (which would apply to most sites except some in the Category 1 level of concern), then quantitative surveys should be undertaken to estimate abundance or relative abundance of breeding birds. The extent and intensity of these surveys will depend on the size and importance of the location. Larger areas would require more extensive surveys to ensure the total area is represented (although the increase in effort would not necessarily be proportional to the total area). Complex habitats such as forested areas may require more intensive surveys than simple habitats such as agricultural fields. The preferred survey techniques will depend on the species using the area. Typically, for song birds, this may involve point counts repeated two or three times under appropriate weather conditions (low wind, no precipitation) in the early morning during the peak breeding season. Such surveys typically require highly skilled birders able to identify all species potentially occurring in the region by sight or sound. To control for variation in the skill of birders, it may be recommended to use electronic recorders with appropriate microphones to make a

permanent record of the birds singing at the location. Other species of birds, such as waterbirds, are typically surveyed using other methods such as area searches.

Quantifying Use of the Site by Passage Migrants or Wintering Birds:
If the habitat at an area is particularly suitable for passage migrants or wintering birds, or geographical considerations suggest that migrants or wintering birds could be concentrated at the site, then quantitative surveys of migrant and wintering birds should be undertaken. Such surveys typically require some sort of area-search method, such as walking a standardized transect that traverses through all of the key habitats on the site. For passage migrants, such surveys should be undertaken throughout the migration season. Depending on the Level of Concern for the site, these surveys may be required on a daily or weekly basis. For wintering birds, weekly or biweekly surveys would often be sufficient. Such surveys should also examine the way that birds are using the area to determine what factors might be attracting birds to the area (e.g., particular food sources) and whether these are likely to vary among years. Such surveys must be conducted in a standardized manner so that they can be repeated, if construction proceeds, to assess how bird usage has changed in response to the turbines.

***Geographic Context*:**
Are there any features nearby (such as lighted structures) that might attract birds to the site, especially during nocturnal migration?

8.2 Additional information required to deal with particular factors of concern

***Breeding Colonies or other Large Concentrations of Birds*:**
If significant breeding colonies of birds are found in or near the proposed area, or if large concentrations of birds occur nearby, either staging or on migration, then surveys should be undertaken to understand the behaviour of the birds, and whether they are likely to be put at risk by the turbines. Such studies need to be undertaken at the same time of year as the bird concentrations are present. These studies should determine how many birds move through the proposed sites of the turbines (e.g., between breeding and feeding locations) and how frequently. Are the birds likely to fly through the site if they are disturbed? At what height are the birds moving through? How close are the proposed turbine sites to important feeding or staging locations, and are these likely to be disrupted by construction?

***Migration Flight Corridors*:**
If the site is in a likely migration corridor (e.g., on a ridge top or a coastal area) where significant numbers of migrants are likely to be flying by, and potentially at risk of colliding with turbines while on migration, then surveys may be required to determine the passage rate of the birds and their altitude flying over the site, especially in relation to the height of the proposed turbines. If the concerns are related to diurnal migrants, such as raptors, then recommended protocols may involve standardized observations and counts during the main migration period. If the concerns are related to nocturnal migrants, then use of radar, thermal imaging or other technologies may be recommended. However, the optimal ways to use some of these technologies are still being determined, and this would normally only be recommended if the risks were judged to be particularly high, or in the context of a research project to assess risks.

8.3 Analysis of survey data

Once survey data have been collected, particularly in the case of category 3 or category 4 projects, it is important to present an analysis of these data in context, to assist the EA project officer to determine the significance of the findings and what mitigation procedures might be most appropriate (see section 9).

Depending on the attributes of the site, these analyses should consider at least the following questions, although additional factors may also be important:

- What species are most likely to be adversely affected by construction and/or turbines, and what percentage of the local population is likely to be affected?
- How significant is the site for this species (*i.e.*, is it one of the few sites in the region or province with this species)?
- What proportion of these species' local habitat would be close to the facility, and what is the likelihood that birds will be displaying in close proximity to turbine blades?
- For colonial species or other concentrations of birds, what proportion of regional and national populations does this colony represent?
- For colonial species or other concentrations of birds, how close are features of the wind farm going to be? Identify all features including roads, power lines, turbines, meteorological towers, storage areas and parking lots, etc., and their proposed distance from the nearest part of the colony's roosting or nesting area.
- What movements or behaviour(s) of these species might lead to increased collision risks (*e.g.,* flight heights, foraging techniques) and how might these risks be minimised?
- Are there options for placing turbines within a site that would minimize disturbance or risk to birds?
- How often does the site have weather conditions (such as dense fog or low cloud cover) that might increase risks to birds, and do these occur at times when bird concentrations are present?

8.4 Special considerations relating to species at risk

The presence of listed species at risk, the residences of individuals of those species or their critical habitat is an indication that special considerations are required. Proponents must comply with the requirements of the *Species at Risk Act (SARA)*.

The *SARA* protects plants and animals listed in Schedule 1 of the Act (the List of Wildlife Species at Risk). *SARA* prohibitions apply to aquatic species and migratory birds protected under the *Migratory Birds Convention Act, 1994* wherever they are found and to all listed wildlife species on federal lands in a province and federal lands in a territory under the authority of the Minister of the Environment or the Parks Canada Agency. For other listed species located outside of federal lands, the provinces and territories are given the first opportunity to protect them through their laws. If those measures are not in place or are insufficient, the *SARA* has a "safety net" whereby certain prohibitions may apply by order of the Governor in Council. *SARA* prohibitions make it an offence to kill, harm, harass, capture or take an individual of a listed endangered, threatened or extirpated species; and to possess, collect, buy, sell or trade an individual of a listed endangered, threatened or extirpated species, or its parts or derivatives. As well, *SARA* prohibitions make it an offence to damage or destroy the residence of one or more

individuals of a listed endangered or threatened species, or a listed extirpated species if a recovery strategy has recommended its reintroduction into the wild in Canada. The *SARA* also provides a way for the government to take immediate action to protect a wildlife species in an emergency. In addition, the *SARA* provides for the protection of critical habitat of listed species through various means.

The SARA also requires that every person required by federal law to ensure that an EA is conducted must (1) notify the competent minister(s) in the likelihood that a project will affect a listed wildlife species or its critical habitat; (2) identify the adverse effects of the project on the listed wildlife species and its critical habitat; and, if the project is carried out, (3) ensure that measures are taken to avoid or lessen the adverse effects and to monitor them. The measures must be taken in a way that is consistent with any applicable recovery strategies and action plans.

For more information on listed species and environmental assessment requirements, please consult the SARA Public Registry at http://www.sararegistry.gc.ca. Guidance material on species at risk and environmental assessment is also available on the CWS website at http://www.cws-scf.ec.gc.ca/publications/eval/index_e.cfm.

8.5 Special considerations relating to offshore projects

Offshore wind farms are only beginning to be developed in North America, and there are still fewer than ten offshore facilities currently in operation in Europe, although a total of about 13,000 turbines are proposed for erection along the European coast. Offshore wind farms provide a major challenge for the prediction and assessment of environmental effects, because it is much more difficult to gather the data outlined in previous sections for offshore sites than it is for terrestrial sites. Currently, no peer-reviewed protocol is available for evaluating the risks to birds of offshore wind turbines, nor is there any previous body of knowledge on which to build. Therefore, baseline information and follow-up requirements for offshore and near-shore wind energy installations must proceed in close collaboration with the regional CWS office.

Among other requirements, numbers of waterbirds (including waterfowl, shorebirds, and seabirds) moving through and feeding in the area should be estimated at various times of year for proposed offshore sites, as well as their direction of movement and the height at which they fly. This must be considered for all times of year when birds are potentially using the area, which may include the breeding season, passage migration or winter, depending on the site. Both diurnal and nocturnal activity should be estimated. Wind farms in near-shore areas (*i.e.*, within 5 km of the coast) may be more likely to intercept flight paths of birds moving between feeding areas (*e.g.,* ducks), feeding and roosting areas (*e.g.,* shorebirds), or breeding and feeding areas (*e.g.,* seabird colonies). Wind farms in these areas may affect larger-scale movements along the coast during migration.

Bird use of offshore and near-shore areas can be estimated using observers on ships, in small boats, in helicopters or fixed-wing aircraft, using radar-tracking techniques or by using pre-existing data from pelagic bird surveys (although these may be sparse in most cases). Aerial surveys are best for covering large areas, whereas ship-based surveys enable more accurate species identification and behavioural observations. In some cases, land-based surveys are possible if the proposed installation is relatively near shore. Radar can be used to measure flight patterns and height, and is particularly useful at night or during times of low visibility.

Bird use studies should include sampling the availability of food for ducks and seabirds, as large concentrations of birds offshore may be related to tidal upwellings of plankton, schools of fish or particularly rich concentrations of shellfish. Studies should consider not only the food availability near the proposed turbines, but also how this compares to other areas, in case birds are displaced by the turbines. The CWS and other agencies, including those working with fisheries, should be consulted for further information on potentially important feeding areas. An evaluation should also be made of the predicted impact of the turbines on the food supply. What is the likely impact of the turbine foundations on water currents and hence marine life? Food availability should be measured in such a way that similar methods can be repeated after construction to determine how the food supply was affected by the turbines, if they are built.

Offshore studies need to be very thorough, covering a large area, because published and accurate knowledge of bird use of most sites is very sparse, and many birds may move long distances each day or night between feeding and roosting areas. Because of the potential for large year to year variation in activities, pre-assessment studies should extend over at least two years.

Analyses of data from an offshore wind farm must consider not only potential mortality, but the potential exclusion effect of the wind farm. Are turbines located on the path of seabirds commuting between their major foraging areas and breeding or roosting sites? Are birds likely to be at risk of collision with the turbines? If birds do avoid the area of the turbines, are they likely to be forced to use less suitable or less productive foraging sites, or to have substantially increased commuting costs?

If the project is built, a detailed follow-up will be needed to verify the actual exclusion effects, the accuracy of the predictions and the effectiveness of any mitigation proposed.

9.0 ASSESSING THE POTENTIAL ENVIRONMENTAL EFFECTS ON BIRDS

Once the baseline information has been gathered, answers provided to the baseline questions will assist in determining what potential environmental effects may result from the project and how important those effects are likely to be. If significant adverse impacts are anticipated, then mitigation measures should be identified to avoid or minimise these adverse effects. Cumulative effects must also be considered.

9.1 Mitigating potential adverse effects

Mitigation measures can occur in three general stages. First is the design stage, where mitigation focuses on reducing the potential impact of a project before it is constructed (which can include rejecting a location because of anticipated substantial negative consequences to birds). Second is the construction stage, where careful planning avoids destroying important habitat and reduces disturbance by focussing the construction at appropriate times of the year and/or away from sensitive areas. Third is the operation stage, where unforeseen problems (higher-than-expected bird collisions, barrier or exclusion effects, etc.) may occur and need to be addressed.

In keeping with the purposes of the *Canadian Environmental Assessment Act*, mitigation to avoid or reduce potential adverse effects should be considered early in the planning process. Depending on the nature of the environmental effects identified, mitigation measures can include avoidance of certain areas (especially sites which present higher sensitivity as outlined in Table 1); and changes to the facility design (see section 3.0).

9.2 Considering cumulative environmental effects

The CEAA requires that an environmental assessment examine the expected cumulative effects that the project will have on the environment. These are effects "that are likely to result from the project in combination with other projects or activities that have been or will be carried out" (CEAA ss.16 (1) (a)) (see Hegmann *et al.,* 1999 for more information, available at: http://www.ceaa-acee.gc.ca/0011/0001/0004/index_e.htm). For wind farms, two types of cumulative effects are most important: disturbance and loss of habitat associated with construction and operation, and direct mortality of birds caused by the turbines. When undertaking a cumulative effects assessment, a proponent should not only consider other wind farms in the area (both disturbance and mortality factors), but any other structure or project that may affect birds. When identifying other projects that will be carried out, proposed projects that are either in some stage of a planning process or have been approved should be included. It is important to identify any residual direct effects from wind turbines, for instance habitat disturbance from turbine placement, as these residual effects are carried forward in the cumulative effects assessment.

From the perspective of direct mortality, population trends over national or regional scales may be an indicator of the significance of this mortality on a given species in the context of all other stressors currently acting on the species. For example, decreases in a species' population over a number of years could be an indication that the cumulative effects of all stressors have crossed a threshold for that particular species making it especially vulnerable to additional sources of mortality. In such cases special attention will be required if substantial mortality is anticipated on that species; for example a Population Viability Analysis for that species may be appropriate. The determination of the significance of the impact will need to take into consideration the effects of the project in the context of all other stressors acting on the species.

Loss of habitat may be of consequence from a cumulative perspective when habitats of species affected by the project have already been subject to adverse effects from other sources, or where future projects are likely to affect the same habitats. In some cases, loss of habitat may be a known factor affecting the species and resulting in decreasing population trends.

Birds, like all other organisms, are affected by changes to their environment in many different ways, and these effects are often difficult to predict without looking at the entire system. One change to their environment may have little impact in and of itself, but combined with other developments, the total or synergistic impact could be significant. The impact of a wind energy facility may be negligible, but if placed in another location where there are many disturbances, birds may be significantly affected. If the area is already subject to a large degree of human-induced bird mortality, any additional source of mortality has the potential to produce a much more important adverse effect overall. Also, any project that could increase the likelihood of birds concentrating in an area, such as the presence of a landfill, could increase the risk of avian mortality caused by wind turbines. Proponents must consider what

surrounds the proposed site and what reasonably foreseeable future projects can be expected in the area. Factors that should be assessed include:

1 the cumulative amount of disturbed habitat relative to the amount of intact undisturbed habitat in the region;
2 the estimated amount of current and additional mortality (due to the presence of tall towers, large numbers of wires or busy roads);
3 habitat rehabilitation or creation that may attract birds;
4 other activities or development projects that may result in birds being displaced; and; other development projects that may attract birds (*e.g.,* flooding for hydroelectric projects, landfills, oil and gas platforms for offshore projects);
5 other development projects that may attract birds (*e.*g., flooding for hydroelectric projects, landfills, oil and gas platforms for offshore projects); and,
6 the presence of any lit structures nearby which could attract birds to the area of the wind power facility.

One aspect that should be mentioned regarding cumulative effects is that there is still a certain degree of scientific uncertainty related to mortality effects of turbines on birds, including whether siting multiple turbines in certain geographic area such as along a shoreline that concentrates bird migration will lead to an increase in bird mortality or loss of habitat function. In such cases, intensive baseline data collection and follow-up programs are likely to be recommended.

10.0 DEVELOPING A FOLLOW-UP PROGRAM

If a project has been approved, then it will usually be appropriate to carry-out a follow-up monitoring program after construction. The purposes of the follow-up monitoring are:

- to evaluate the predictions made during the environmental assessment process to allow for improved predictions in the future;
- to determine whether any mitigation measures that had been proposed were effective;
- to determine whether any unanticipated impacts are occurring and, if so, to identify any possible mitigation measures;
- to obtain quantitative information on the impacts of the project, that can be used to understand cumulative effects more accurately;
- to inform future decisions about development or placement of wind turbines.

As with baseline surveys, the amount and type of follow-up surveys required will depend on many factors, including the Level of Concern category of the project (as described in section 7.0), the nature of the particular factors that led to this classification, and any unanticipated factors that may arise during construction. In general, the follow-up program should be designed in consultation with the regional CWS office. Furthermore, the results of follow-up should normally be provided to the CWS.

Where the environmental consequences are greater than anticipated, or when the initially proposed mitigation is shown to be ineffective, additional mitigation may be required (see section 12 on Adaptive Management).

The follow-up work should always be conducted or managed by a qualified bird biologist. For the purpose of assessing changes in the bird community post-construction, it will usually be desirable to have the same person conduct post-construction surveys as had conducted the baseline surveys, to ensure comparable methodology, and to reduce observer effects, although this requirement can be relaxed if some of the surveys involved electronic recordings and microphones. New surveys that may be required, however, such as carcass searches, can involve different personnel.

The following sections describe briefly the types of monitoring that is likely to be required. Further details of the protocols are provided in the companion document "Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds." As with baseline monitoring, whenever possible, protocols should be selected from among those recommended techniques, so that data from multiple sites can be pooled to enhance our understanding of the impacts of turbines on birds. All proponents are strongly encouraged to contribute their survey data to a standardized data base, to ensure that maximum use can be made of these data.

10.1 Estimating impacts of wind turbines on bird usage in the project area

For nearly all sites, quantitative surveys should be undertaken to determine how bird usage in the area compares with bird usage pre-construction.

Whenever possible, these surveys should be undertaken using comparable methods to those undertaken during the pre-construction phase, so that changes can be estimated.

***Habitat Impacts*:**
If the site contained habitat of potential value for birds, how much and what types of this habitat were altered or removed by construction? If mitigating measures were proposed (such as restoration of any areas damaged during construction), are these areas growing back appropriately? In most cases, a map of the site should be prepared that shows the post-construction habitat in relation to what was there pre-construction. Initial surveys should generally be carried out within a year of construction. If there is reason to believe this habitat will change substantially over time (e.g., due to restoration activities, or successional patterns), or if areas of particular importance to birds may have been affected, then follow-up surveys in subsequent years may be required. Such surveys should generally be undertaken in the breeding season. The time required will be a function of the size of the installation.

***Changes in Breeding Bird Numbers*:**
If pre-construction surveys indicated the site has breeding populations of native bird species (which would apply to most sites except some in the Category 1 level of concern), then follow-up surveys should be undertaken using the same sampling methods as the initial surveys. In most cases, such surveys should be undertaken over at least 2 years, to obtain some measure of annual variation in abundance. If the anticipated impacts were relatively low (e.g., most Category 1 or 2 projects), it may be sufficient to wait at least one year post-construction before commencing surveys, to get a better estimate of long term impacts, after the initial disturbance caused by construction. However, for category 3 or 4 projects, with a higher anticipated level of risk, it would usually be desirable to undertake at least some surveys in the year immediately post-construction to determine whether any unanticipated adverse impacts have occurred, such that appropriate mitigation measures can be

implemented if necessary. This is particularly important if the site contained or was near large colonies of birds, or if it supported any species at risk. If surveys in the initial two years indicated dramatic and unexpected changes in bird populations, it may be desirable to continue surveys for additional years, to determine whether the populations may recover.

Changes in Use of the Site by Passage Migrants or Wintering Birds:
If baseline surveys indicated that significant numbers of birds were using the site outside of the breeding season (this would usually only be anticipated for some category 3 or 4 projects), whether as a stopover or staging area or for over-wintering, then follow-up surveys should be undertaken to determine how this usage has changed. Such surveys should usually be undertaken using the same or comparable methods as were used for pre-assessment surveys, so that the results can be readily compared. Depending on the variation in the site detected during pre-construction surveys, surveys of passage migrants may be required on a daily or weekly basis. For wintering birds, weekly or biweekly surveys would often be sufficient. Numbers of birds using particular migration and wintering areas are often highly variable from year to year, such that fairly extensive surveys are required to get a reasonably precise measure of any changes that may have occurred. In most cases, two years of data should be sufficient to detect major changes at a given site. If data can be combined from many different sites, two years of data can also be sufficient to detect more subtle effects. However, if the initial surveys indicated major changes in bird populations, or if there were major concentrations of significant species using the site (usually only for some category 4 projects) then surveys may be required for additional years. Such surveys would typically be limited in extent, and targeted at particular species (e.g., wintering populations of seabirds or stopover concentrations of shorebirds).

10.2 Estimating bird collision rates

For many sites with levels of concern in category 3 or 4, where the concern was related to potential direct mortality impacts of turbines on birds, surveys are required to estimate the levels of mortality associated with wind turbines after they were constructed.

10.2.1 Carcass searches

The most widely used technique for estimating direct mortality caused by turbines involves searching for carcasses around the bases of installed wind turbines. Note that to permits are required to handle any birds found– see note below. This section provides a basic overview of methods that can be used. Details on recommended protocols are provided in the document "Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds." As with other survey methods, proponents should consult with local CWS biologists to ensure that the methodology selected is that most appropriate for the particular circumstances at the site.

In most cases, only a limited proportion of the area around a turbine can be searched, and only a limited proportion of birds or bats that hit a turbine will actually be found. To estimate the total number of birds or bats actually killed by a turbine, it is necessary to estimate the proportion of carcasses that are likely to be found. Several factors influence this, including the exact extent of the area around a turbine that is searched, the frequency of the searches, and the search efficiency of the observers.

Search Area

Birds or bats colliding with a turbine can potentially fall over a very large radius around the turbine. While it is generally believed that most carcasses fall relatively close to the turbine, some could potentially be flung up to several hundred metres from the turbine if they hit the top of a blade moving at maximum rotation. It is clearly not cost-effective to search the complete area over which carcasses might land and, in many cases it is not possible because of topographic constraints or dense vegetation. Thus, it is necessary to select a limited search area. This area should be chosen so that the search can be carried out efficiently (e.g., with minimal vegetation) and where the highest concentration of carcasses might be expected. Research is currently underway to understand better the distribution of carcasses around a turbine, and to develop reliable correction factors, but current recommendations suggest that efforts should be concentrated between the base of the turbine and a radius equal to the length of the turbine blades, and downwind of the turbine based on prevailing winds in the days since the last search. The area selected should be chosen so that it has minimal vegetation. The simplest design involves even search effort throughout the defined search area, though more complex designs, involving stratified sampling are more efficient, but harder to analyse. In either case, data on prevailing wind speeds and directions will be required to analyse the results.

Frequency and timing of searches

Carcass searches should be carried out at the time of year when there is the greatest concern about direct mortality impacts of turbines. This could be during the breeding season, during migration or in winter, depending on the anticipated risks. Regular searches are required to minimize the number of carcasses that are scavenged or otherwise disappear. The recommended search frequency may vary from daily to weekly, depending on the anticipated number of birds being affected, the size of the installation, and any prior information on scavengers present on the site. If the installation includes a large number of turbines, the optimal sampling design may involve searching different turbines on different dates. For any sampling design, accurate and complete records must be kept of the dates, times and locations when searches were carried out, and the effort undertaken. In cases where predicted mortality may vary through the season or in relation to weather, a sampling protocol can be selected with increased sampling intensity on days when higher mortality is expected. This increases the efficiency of the search effort, but requires more complex analysis.

Search methodology

Even the most skilled of observers will overlook some carcasses that were present when they conduct their search. Thus, it will always be necessary to estimate the proportion of carcasses that were overlooked. Nevertheless, it is also appropriate to maximize the proportion of birds that are found, to increase the precision of the mortality estimates, by using the most efficient search methods available. Trained dogs have been found to substantially increase search efficiency, and should be used when possible. Because different searchers may vary in their efficiency, carcass searches should normally be conducted by the same observer or team of observers, using the same methods, throughout the study.

When a carcass is found, the precise position should be recorded (i.e. distance and direction from the nearest turbine), and the carcasses should be collected (with appropriate permits) for confirmation of identification and, if appropriate, for necropsy to determine cause of death. Carcasses can be kept frozen and may, after examination, either be discarded or used for searcher efficiency trials (ensure that the permit authorizes the appropriate use).

Regardless of the searching method, it is important to estimate the search efficiency. One method of doing this involves trials in which carcasses are placed around turbines, within the searched areas. Such placements must be done by independent observers and, ideally, without the knowledge of the person doing the search (who may, otherwise, increase search efficiency). The sample size must be adequate to obtain a reasonably precise correction factor. Ideally, trials should be spread throughout the survey period, with only a few carcasses placed on any given date. Placement of carcasses can also be used as a method to estimate scavenging rates at the same time, by checking, after the fact to determine whether any of the trial carcasses that were not retrieved were still present, or had been scavenged. Detailed recommendations for these trials are provided elsewhere.

Data Analysis and Reporting
All proponents are encouraged to store data from their carcass searches in a centralized data base, to allow analyses of results from many different sites, thus enhancing our understanding of wind turbine impacts. Data to be stored include information on the search effort (area searched, dates and times of all searches, observer identity), the carcasses found (species, condition, date, time and precise location in relation to the nearest turbines), information on wind strength and direction (to estimate where birds might have fallen), as well as data on the search efficiency trials.

Proponents should also carry out their own analyses to estimate total mortality, using the best available analysis methods. Contact the CWS for the currently recommended approaches.

Permits
Permits are normally be required to handle any dead birds or bats found during carcass searches or used as part of observer efficiency or scavenging trials, as follows:

- Under the *Migratory Birds Regulations*, a scientific permit is required for the collection of a migratory bird (dead or alive), feathers, or parts of a migratory bird, as defined in the *MBCA*.
- For salvage of migratory bird species listed as endangered or threatened under the *Species at Risk Act*, an additional permit is required.
- Proponents should also contact the appropriate provincial or territorial wildlife agency for information related to requirements to collect species under provincial jurisdiction (bats and bird species such as raptors not covered by the MBCA).
- Permits should clearly specify how the carcasses may be used (e.g., whether they can be used for observer efficiency trials, or whether they need to be provided to the CWS).

It is the responsibility of the proponent to ensure that all permits are in hand before studies commence. Canadian Wildlife Service may also require that the carcasses of species listed as threatened or endangered be sent to the nearest office of the CWS.

10.2.2 Estimating collisions using radar and other technological solutions

A variety of technological methods are also available for studying bird behaviour around wind turbines, and for estimating rates of collisions. Radar and thermal imaging equipment can be used to monitor bird behaviour automatically, and may be able to estimate collisions from tracks of birds that disappear at a turbine. Recordings of flight calls can estimate numbers of certain species flying over at night and, if based on an array of microphones, can estimate the height and position of each bird when it calls. Direct, visual observations of birds around turbines can also be valuable of understanding how birds behave around wind turbines during the day.

Each of these methods has both advantages and disadvantages. In most cases, neither radar nor thermal imaging equipment can be used to identify the species of birds involved, although there are a few exceptions such as when a bird species has a very distinctive flight pattern or when only a few species of very different sizes occur in an area. Effective use of either of these approaches requires sophisticated computer algorithms to process large amounts of data automatically to detect potential collision events, because many hundreds of hours of recordings may need to be scanned to detect events. With radar, detecting collisions depends on following a track that disappears when it reaches the turbines – this may overlook collisions in some cases. Thermal imaging methods may be able to observe collisions directly, but can only view a limited area, usually one turbine at a time. Nevertheless, the ability to automate analyses can make either of these technologies useful in circumstances where carcass searches may be ineffective, such as in offshore sites, or as a research tool to understand better the relationship between carcasses found and total numbers of collisions.

Visual observations can identify bird species, but are limited to daytime with good visibility. Furthermore, there are limits to how effectively observers can concentrate on observations. As such, they can be an effective means of understanding behaviour of diurnal birds such as raptors around turbines, but are of limited value for measuring collisions. Recordings of nocturnal flight calls can also be effective for monitoring activity of nocturnal migrants around turbines, but cannot be used to measure collision rates.

A system specifically designed to measure bird collision rates has been developed that combines microphones placed in the turbine structure (to detect the sounds of a collision) with a video camera (to record what hit the turbine). A computer is programmed to store video images from shortly before and after any unusual sounds (which may represent a collision). Tests have shown that it can effectively detect artificial collisions (e.g. tennis balls), but further testing is required to determine how well it will detect actual bird collisions (Verhoef et al. 2003). Replacing the video camera with a thermal imaging system may be required to detect nocturnal collisions.

At present, none of these technologies is sufficiently developed to recommend their use routinely for post-construction monitoring. Nevertheless, many of them are appropriate for research tools, to understand better collision risks, particularly in sites with elevated levels of concern with respect to collision risk. As the technologies are developed, it may be appropriate to recommend their use more widely in the future.

10.3 Special considerations at offshore wind farms

Post-construction monitoring at off-shore and near-shore wind energy installations can be particularly challenging. Measuring bird mortality at offshore wind farms is difficult and will be largely dependent on technology approaches, such as radar or infrared/thermal imaging systems, or the combined microphone and video system as described in the preceding section. It has been proposed to place nets under turbines to catch fatalities, but these could be vulnerable to storm events or strong winds.

Post-construction monitoring is particularly important to measure displacement effects, as well as the impact of the turbines on aquatic food supplies. As much as possible, studies of these effects should use similar methodology to pre-construction monitoring, so that results will be directly comparable.

As for terrestrial sites, the appropriate sampling design and duration of the follow-up studies will depend on the characteristics of the installation. For offshore and near-shore sites factors to be considered include the location of the turbines, their distance from shore, the species of birds present, the sensitivity and level of concern for these species, and the size both in surface area and turbine number of the wind farm.

Both the baseline information surveys and follow-up up programs must be done over a period of at least 2 years, with a minimum of three years in ecologically sensitive sites, because shorter term studies may not provide results representative of the average annual conditions: there is more variability at offshore sites than at onshore. Follow-up studies should consider diurnal, tidal-cycle, species-related, weather-related and seasonal variation in site use by birds.

11.0 ADAPTIVE MANAGEMENT

Most wind farms will cause some incidental bird mortality. The EA will recommend mitigation measures to avoid or lessen the potential adverse effects on birds, and will predict the likely significance of any residual effects after mitigation has been implemented. Follow-up (described in section 10) is required to determine the actual direct impacts on birds.

Where a follow-up program demonstrates that unanticipated impacts are occurring, such as a high number of direct fatalities or higher than expected disturbance effects, additional monitoring to determine the reason for these environmental impacts may be needed and modifications to the turbine design or operation may be needed.

For example, where the incidental mortality rate is higher than expected, or where sensitive species (species at risk, COSEWIC, or provincially-listed) have been killed, the proponent should determine whether there are particular turbines consistently involved. An examination of the placement of the problem turbine(s) should then be undertaken. Questions to consider include: Where is the problem turbine(s) located in relation to topographic features and in relation to the other turbines? What site-specific conditions, or other local conditions (such as the cropping practice in an agricultural setting), set it apart from the other turbines? If it is found that 'problem' turbines have characteristics that set them apart from others, several things can be tried, depending on the bird species affected (see below), to reduce mortality before the turbines should be decommissioned or moved to a new location (both of which would be considered "last resort" methods). Adopting an adaptive approach and reporting on the successes and the failures of certain methods will help to guide future research and development in wind energy.

If mortality is due to attraction to lights, other lighting options may need to be considered. For example, if night-flying migrant landbirds are affected primarily during periods of inclement weather conditions (*e.g.*, when a large number of fog days, occur during the spring and fall migration periods), an evaluation of other options for lighting at the site may need to be conducted in co-operation with Transport Canada and the Canadian Wildlife Service. It may be possible to reduce the amount of

lighting or even to turn lights off during periods of high risk (*e.g.,* foggy nights during the peak of the passerine migration period). A search for other sources of lighting at or near the site (*e.g.,* at neighbouring communication or meteorological towers, or at power substations or maintenance sheds) which may be attracting birds is also recommended. Should mortality be attributed or partially attributed to these additional lighting sources, it may be possible in some cases to reduce or remove them.

Several mitigation options have been suggested for reducing raptor collisions at wind facilities. If there are high densities of raptors using the area, it may be appropriate to attempt to reduce the number of raptors present through a prey control program and/or removal of other raptor food sources (carrion) at the site. Perching opportunities such as lattice towers, guy wires, hydro poles or other structures should be reduced or removed whenever possible.

If a moving blade appears to be causing high bird mortality along a particular flight path, the turbine can be shut down during time periods, or weather conditions when risks are particularly high, to reduce the number of direct hits.

If birds are killed at an agricultural site where they appear to be feeding on crop residues, perhaps the area under the turbine(s) can be planted in a crop that is less attractive. If grassland birds such as Bobolinks are being killed during aerial displays at particular turbines, it may be possible to offset losses in productivity if hay cutting can be delayed at adjacent sites.

Unanticipated adverse effects may require special mitigation strategies which could include a range of options to be developed under each specific circumstance. For example, if disturbance effects are found to be greater than anticipated, and various mitigation strategies prove unsuccessful, other options could include encouraging the proponent to purchase and then protect (with conservation easement or other method) a parcel of land of similar size and habitat type, and within the same general region. In extreme cases, if a wind farm results in high collision rates and/or is killing unacceptable numbers of species at risk, and all other mitigation options have been unsuccessful, it may be necessary to deactivate and remove the turbine(s) responsible.

APPENDIX A: SOURCES OF INFORMATION

Information on bird mapping and surveys

- NABCI

  For information on the North American Bird Conservation Initiative (NABCI), including maps and descriptions of Canadian Bird Conservation Regions (BCRs), visit:

  http://www.bsc-eoc.org/nabci.html

  or

  http://www.cws-scf.ec.gc.ca/birds/nabci_e.cfm

- Regional Bird Conservation Plans

To obtain a copy of the BCR plan for your region, contact:

Canadian Coordinator, North American Bird Conservation Initiative
Tel: (819) 994-0512
Fax: (819) 994-4445
E-mail: Silke.Neve@ec.gc.ca

- For information on provincial or regional bird sightings, lists, nature list-servs, etc, visit: Birding in Canada website: http://www.web-nat.com/bic/

- For information on regional hawk, owl, woodpecker and other bird surveys, visit: Bird Studies Canada: www.bsc-eoc.org

- Important Bird Areas of Canada: http://www.ibacanada.ca/

- For information on National Wildlife Areas or Migratory Bird Sanctuaries,: http://www.cws-scf.ec.gc.ca/habitat/default.asp?lang=En&n=7F335AFF-1

Environment Canada /Canadian Wildlife Service contacts:

- Canadian Wildlife Service – this general website directs readers to the CWS regional websites which provide contact information for each region: http://www.cws-scf.ec.gc.ca/index_e.cfm
- The Migratory Birds Convention Act and Regulations: http://www.pnr-rpn.ec.gc.ca/nature/migratorybirds/dc00s06.en.html

- Environment Canada EA program and list of regional contacts is provided at http://www.ec.gc.ca/ea-ee/home/regions_e.asp

Information on existing environmental assessments

- Canadian Environmental Assessment Registry at

  http://www.ceaa-acee.gc.ca/050/index_e.cfm

Information on species at risk:

- The General Status of Species in Canada: http://www.wildspecies.ca/
- To determine if a species is listed by COSEWIC or has legal standing under SARA, visit Environment Canada's Species at Risk website: www.speciesatrisk.gc.ca
  - SARA Public Registry: http://www.sararegistry.gc.ca/default_e.cfm
  - Regional Conservation Data Centre websites are available through NatureServe Canada: http://www.natureserve-canada.ca/english/map.htm

Local naturalists groups

- To contact a local naturalists' club, visit the website of the appropriate provincial naturalists' society:

  Federation of British Columbia Naturalists: http://www.naturalists.bc.ca/

  Federation of Alberta Naturalists: www.fanweb.ca

  Nature Saskatchewan: www.naturesask.com

  Manitoba Naturalists' Society: www.manitobanature.ca

  Ontario Nature: www.ontarionature.org

  L'Union québécoise pour la conservation de la nature: www.uqcn.qc.ca

  New Brunswick Federation of Naturalists/Fédération des naturalistes du Nouveau-Brunswick: www.naturenb.ca

  Federation of Nova Scotia Naturalists: http://www.chebucto.ns.ca/Environment/FNSN/menu.html

  Natural History Society of Prince Edward Island: http://www.isn.net/%7Enhspei/nhsAbout.htm

  Natural History Society of Newfoundland and Labrador: www.nhs.nf.ca

APPENDIX B: LIST OF ACRONYMS

CDC: Conservation Data Centre
CEAA: *Canadian Environmental Assessment Act*
COSEWIC: Committee on the Status of Endangered Wildlife in Canada
CWS: Canadian Wildlife Service
EA: environmental assessment
EC: Environment Canada
FA: Federal Authority
IBA: Important Bird Area
MBS: Migratory Bird Sanctuary
NABCI: North American Bird Conservation Initiative
NIHC: National Heritage Information Centre
NWA: National Wildlife Area
PIF: Partners in Flight
RA: Responsible authority
SAR: Species at risk
SARA: *Species at Risk Act*
WHSRN: Western Hemisphere Shorebird Reserve Network
WPPI: Wind Power Production Incentive

APPENDIX C: EXAMPLES TO ILLUSTRATE THE SITE SENSITIVITY TABLE (TABLE 1)

1. Very High sensitivity:

Presence of a SARA listed bird species, the residence (s) of individuals of that species, or critical habitat, of a nature or proximity that could lead to potential adverse environmental effects (determined through baseline research and consultation with Environment Canada)

- Note that this factor is not limited to the presence of a SARA-listed species, but to a possible adverse effect upon that species, its residence or critical habitat.
- A windfarm has been proposed for an area where Red Crossbills have been sighted in the past, but that do not constitute good habitat for this endangered species. Depending on the site-specific circumstances, it may be determined that the project is unlikely to have an adverse effect on the crossbills. The "very high" site sensitivity did not apply although baseline surveys were designed to validate the information on the Crossbill.
- In another case, a windfarm was proposed for an area frequented by Marbled Murrelets, a SARA species listed as threatened. While the exact patterns of movement within the area were unknown, these birds' behaviour and flight patterns put them at a higher risk of collisions. For this reason the site sensitivity was considered "very high".
- A proposal of over 100 turbines is planned for an inland area that is fairly intensively farmed. A literature search reveals records of Henslow's Sparrow in the vicinity of the project. However, this endangered SARA-listed species has not been sighted in the area for 16 years. The proponent undertook a survey using sound playbacks at three locations with potentially suitable habitat but did not find any Henslow's Sparrows. There were no other features present that would increase the site sensitivity which was then ranked as "low".
- A small wind farm was originally proposed for an area of actively farming 2 km away from a lake shoreline, in an area considered to be "low" sensitivity. A new location was then proposed for the facility in a heavily forested area north of the original site. In this area the cumulative loss of forest habitat has been such that the Landbird Conservation Plan for that BCR identifies the "protection of existing forests" as one of the highest priorities. Three species at risk are found at the new site: one is on SARA Schedule 1 as endangered, another is listed by COSEWIC as being of special concern, and the third is on SARA Schedule 1 as special concern. In addition, several other features were present at this site, now considered to be of "very high" sensitivity. Because of the number of features present and the nature of the concerns, CWS strongly recommended reconsidering the change of location of the facilities.

Site contains other bird species at risk (COSEWIC species or species designated by provincial or territorial governments) of a nature or proximity that could lead to potential adverse environmental effects (determined through baseline research and consultation with Environment Canada)

- Note that this factor is not limited to the *presence* of a sensitive species, but also to a possible adverse effect upon that species or its critical habitat;
- A large wind farm is proposed in a provincial protected area, close to existing turbines. All new towers would be located within Bicknell Thrush habitat. This bird has been assessed by COSEWIC to be of special concern and is on Schedule 3 of SARA. Schedule 3 identifies species that were designated at risk prior to 1999 and must be reassessed using revised criteria before they can be considered for addition to Schedule 1 (the official list of wildlife species at risk under SARA). Loss of habitat has been identified as one of the threats faced by the Bicknell's Thrush. The site was therefore considered of "very high" sensitivity.

Site contains significant staging or wintering area for waterfowl or shorebirds, or significant areas of bird concentrations.

- A wind farm is proposed within the shallows off a provincial park on the Queen Charlotte Islands. In this area upwelling currents produce food for pelagic species. This area is considered an important sea duck wintering habitat and also includes important staging habitat for the Sandhill Crane**.**

Site is, or is adjacent to, an area recognised as nationally important for birds (*e.g.,* by being located in or adjacent to a National Wildlife Area, Migratory Bird Sanctuary, Important Bird Area, National Park, WHSRN site, or similar area specifically designated to protect birds).

- A large wind farm of over 130 turbines is proposed adjacent to and surrounding a Migratory Bird Sanctuary designated as an important migration and staging site for the Greater Snow Goose, many ducks and the Canada Goose. More than 260 bird species have been recorded within the sanctuary. The site is also classified as a RAMSAR site. Because of its location the site was considered of "very high sensitivity".

- A small windfarm (10 turbines) is proposed adjacent to a National Wildlife Area that is an annual staging area for a globally significant portion of Tundra Swans, in addition to Sandhill Cranes and waterfowl. The staging birds move daily from the NWA to the adjoining fields to feed. Because of annual use of the site by significant numbers of staging birds, and the importance of the adjacent fields for feeding areas, the site is considered as "very high sensitivity."

Site contains large concentrations of raptors (determined through baseline research and consultation with Environment Canada and provincial or territorial agencies).

- An island periodically contains high densities of voles, a favoured raptor prey, in the general vicinity of a proposed turbine installation. The vole population fluctuates on a four- or five-year cycle. At the cycle's peak, the huge vole population attracts exceptional numbers of hawks and owls that begin arriving on

the island in fall and remain there until March and April. In some years, daily winter raptor counts approach or exceed 100 individuals of several species, and scores of individuals of other species. In peak years, the site regularly claims continent-high tallies for wintering Snowy Owls. Because of the site's importance to wintering raptors, it is considered to be "very high sensitivity."

Site is on a known migration corridor.

- A small windfarm (3 turbines) is proposed on the northern border of a national park, internationally renowned for the magnitude of its landbird migrations. The park is located on a peninsula, and huge numbers of nocturnal and diurnal migrants traverse the area in spring and fall. Because of its critical importance to migrants, the site is considered to be of "very high sensitivity."

2. High sensitivity

Site contains one or more landform factors that concentrate birds (*e.g.,* islands, shoreline, ridge, peninsula or other landform that may funnel bird movement) or significantly increase the relative height of the turbines.

- A large windfarm is proposed on a long, steep, forested ridge located several km inland from one of the Great Lakes, and running parallel to the shoreline. Large numbers of waterbirds (loons and grebes) and landbirds (raptors, passerines, etc) migrate along and over the ridge. The combination of physical features ─ ridges, rugged topography, shoreline ─ and high bird usage resulted in a "high sensitivity" designation for the site.

Site is located between habitats where large local bird movements occur, or is close to significant migration staging or wintering area for waterfowl or shorebirds.

- A large windfarm is located several km from a NWA where large numbers of Tundra Swans, Sandhill Cranes, and waterfall congregate every spring. Feeding birds frequently exploit the fields in the immediate vicinity of the turbines. The site is designated as "high sensitivity" because of the regular daily movement of birds to and from the turbine site.

Site subject to increased bird activity from the presence of a large heron, gull, tern or seabird colony located in the vicinity of the site (determined through baseline research and consultation with Environment Canada).

- A medium-sized windfarm is proposed for an area located 4 km from a large tern colony (750 nests). Preliminary information suggests that a sandbar adjacent to the proposed farm is used as a staging are for terns. The site is considered "high" sensitivity.

Site is subject to increased bird activity from the presence of an area recognised as nationally important for birds (*e.g.,* a National Wildlife Area, Migratory Bird Sanctuary, National Park, Important Bird Area or similar provincially or territorially protected area).

Site contains species of high conservation concern (*e.g.,* birds known to have aerial flight displays, PIF/CWS priority species, etc.).

- A small wind farm of five to ten turbines is proposed for a coastal area that is located ~14 km from a seabird Ecological Reserve which includes, among other species, the largest colony of Leach's Storm petrels in the world. These birds are strongly attracted to light and have been known to travel over 20 km to light sources. While the potential for fatalities is unknown, the consequences could be serious given the size of the colony. The area is considered "high sensitivity" and additional baseline and monitoring data will be required.
- A large wind farm is proposed in a farmed area that also includes locally and provincially significant wetlands. The wetlands are not important waterfowl staging or breeding areas and the turbines are located away from the wetlands in fields or areas of permanent grass cover. Grassland species include Bobolinks and Horned Lark, both of which have aerial flight displays. However, it was determined that fatalities were unlikely given the fact that the Horned Lark were present in very low numbers, and that the Bobolinks flight displays were generally too low to create a high risk from turbines. As a result the site sensitivity was ranked "low".

3. Medium site sensitivity

Site is recognised as regionally or locally important to birds, or contains regionally significant habitat types (*e.g.,* large contiguous tracts of forest or wetland).

- A small windfarm is proposed in an agricultural area about 8 km from a major roosting area for migrating Sandhill Cranes. Cranes forage in fields throughout the region, including those in the immediate vicinity of the proposed windfarm. Small flocks of cranes have been regularly feeding in the area or flying over the site; but because the number of observed cranes at the site is small, and because the site is a considerable distance from the roosting area, the site is designated as "medium risk."

4. Low site sensitivity

Site does not contain any of the elements listed above and has no significant species or recognised conservation features.

- A small windfarm of 6 turbines is proposed for an inland area consisting of second growth mixed forest, blueberry fields, and clear-cut areas. No avian species at risk are known to occur in the vicinity of the project t area, and there are no known migration routes for birds in the area. The site is considered a low sensitivity.
- A large wind farm is proposed on intensively-used agricultural lands close to the St. Lawrence River. There are no species at risk in the area, no known migration corridors, no colonies or protected areas. The site sensitivity is rated low.

5. Special considerations:

Site contains a SARA listed species, the residence(s) of individuals of that species or critical habitat.

- See examples provided under “very high site sensitivity”;
- In addition to the above, the requirements of the Species at Risk Act must be met. See section 8.5 of this guide; in additional guidance on SARA is provided on the SARA Public Registry at http://www.sararegistry.gc.ca. EA guidance material on meeting the requirements of SARA is also available on the CWS website at http://www.cws-scf.ec.gc.ca/publications/eval/index_e.cfm
- For example, a medium-sized windfarm was proposed on native prairie pasture in an area that contained several listed plant species at risk. In addition to the CEAA requirements, section 79 of SARA requires that every federal EA identify the potential adverse effects on listed species and its critical habitat, and, if the project is carried out, that measures are taken to avoid or lessen those effects and to mitigate them. Such measures must be consistent with applicable recovery strategies and action plans. A detailed survey of the plants was undertaken and mitigation included avoiding the areas where the plants were found.
- In all cases, it is the proponent’s responsibility to comply with the requirements of SARA, including all SARA prohibitions.

Proposed project is located offshore.

APPENDIX D: Federal, Provincial and Territorial Wildlife Jurisdictions

General Federal and Provincial Wildlife Responsibilities

Species Group	**Federal**	**Provincial/Territory managed species**	**Applicable Act**
Migratory Birds protected by MBCA	X		Migratory Birds Convention Act, 1994
Other Birds including raptors and upland game birds		X	Provincial/Territorial Wildlife Acts
Mammals (including bats)		X	Provincial/Territorial Wildlife Acts
Amphibians		X	Provincial/Territorial Wildlife Acts
Reptiles		X	Provincial/Territorial Wildlife Acts
Fish	X		Fisheries Act

REFERENCES

Anderson, W.L., M. Morrison, K. Sinclair and D. Strickland. 1999. Studying wind energy/bird interactions: a guidance document. National Wind Coordinating Committee. 88 pp.

Australian Wind Energy Association. 2002. Best practice guidelines for implementation of wind energy projects in Australia. Prepared for Australian Greenhouse Office. Available online: http://www.auswea.com.au.

Cooper, B.A., A.A. Stickney and T.J. Mabee. A visual and radar study of 2003 spring bird migration at the proposed Chautauqua wind energy facility, NY. A report by ABR, Inc. Environmental Research & Services for Chautauqua Windpower LLC, 27 April 2004. http://www.abrinc.com/Brochures/Visual%20and%20Radar%20Study%20of%20Bird%20Migration,%20Chautauqua%20%20Wind%20Energy%20Facility,%20NY,%20Spring%202003.pdf

Desholm, M. 2003. Thermal Animal Detection System (TADS). Development of a method for estimating collision frequency of migrating birds at offshore wind turbines. *NERI* National Environmental Research Institute Technical Report, No. 440, Denmark. http://www.dmu.dk/1_viden/2_Publikationer/3_fagrapporter/rapporter/FR440.pdf

Desholm, M., T. Fox and P. Beasley, 2005. Best practice guidance for the use of remote techniques for observing bird behaviour in relation to offshore windfarms. First Draft for comments, version 21-03-2005. Collaborative Offshore Wind Energy Research into the Environment (COWRIE).

Dirksen, S., A.L. Spaans and J. Winden 1998. Nocturnal collision risks with wind turbines in tidal and semi-offshore areas. Pp. 99-108. In Wind Energy and Landscape. Proceedings of the 2nd European and African Conference on Wind Engineering, 1997.

Gauthreaux, S.A. Jr. and C.G. Belser. 2003. Radar ornithology and biological conservation. Auk 120:266-277.

Harmata, A.R., G. Leighty and E.L. O'Neil 2003. A vehicle-mounted radar for dual-purpose monitoring of birds. Wildlife Society Bulletin. 31(3): 882-886.

Jacques Whitford Environment Limited. 2003. Protocol for bird migration monitoring at the proposed Royal Road Wind Farm. Prepared for Vision Quest Windelectric Inc., March 2003.

James, R.D. 2002. CNE wind turbine bird mortality monitoring program. Unpublished report prepared for Environment Canada, Downsview, ON.

Johnson, G. D., W.P. Erickson, M.D. Strickland, M.F. Shepherd, D.A. Shepherd, and S.A. Sarappo. 2002. Collision mortality of local and migrant birds at a large-scale wind-power development on Buffalo Ridge, Minnesota. Wildlife Society Bulletin 30: 879-887.

Kahlert, J., M. Desholm, I. Clausager and I.K. Petersen. 2000. VVM-redegørelse for havvind-møllepark ved Rødsand. Teknisk rapport vedrørende fugle. DMU report to SEAS. As cited in Langston and Pullan 2002.

Langston, R.H.W., and J.D. Pullan. 2002. Windfarms and birds: An analysis of the effects of windfarms on birds, and guidance on environmental assessment criteria and site selection issues. Birdlife International on behalf of the Bern Convention. Convention standing committee, 22nd meeting.

Larkin, R.P. and B.A. Fraser. 1988. Circular paths of birds flying near a broadcasting tower in cloud. Journal of Comparative Psychology 102: 90-93.

Lock, A.R. 1994. Gazetteer of marine birds in Atlantic Canada: an atlas of seabird vulnerability to oil pollution. Canadian Wildlife Service, Atlantic Region, 1994.

Morrison, M.L. 1998. Avian risk and fatality protocol. National Renewable Energy Laboratory, Golden, Colorado.

Percival, S.M. 2001. Assessment of the effects of offshore wind farms on birds. Report ETSU W/13/00565/REP, DTI/Pub URN 01/1434.

Spaans, A., L. van den Bergh, S. Dirksen and J. van den Winden. 1998. Windturbines en vogels: Hoe hiermee om te gaan? De Levende-Natuur 99: 115-121.

SunBridge. 2002. Unpublished draft monitoring guidelines for the SunBridge Wind Power Project at Gull Lake, Saskatchewan - a joint venture between Suncor Energy Inc. and Enbridge Inc.

Tulp, I., H. Schekkerman, J. K. Larsen, J. van der Winden, R.J.W van de Haterd, P. van Horssen, S. Dirksen and A.L. Spaans. 1999. Nocturnal flight activity of sea ducks near the windfarm Tunø Knob in the Kattegat. IBN-DLO Report No. 99.30. (As cited in Percival 2001.)

Verhoef, J.P., C.A. Westra, P.J. Eecen, R.J. Nijdam, and H. Korterink. 2003. Development and first results of a bird impact detection system for wind turbines. Paper presented EWEC, 16-19 June 2003, Madrid Spain. http://www.ecn.nl/docs/library/report/2003/rx03035.pdf