



# Adaptive Management Guidelines for Saskatchewan Wind Energy Projects

Ministry of Environment

# **ADAPTIVE MANAGEMENT GUIDELINES FOR SASKATCHEWAN WIND ENERGY PROJECTS**

June 2018

## **SUGGESTED CITATION FOR THIS GUIDELINE**

Saskatchewan Ministry of Environment. 2018. Adaptive Management Guidelines for Saskatchewan Wind Energy Projects. Saskatchewan Ministry of Environment, 3211 Albert Street, Regina, Saskatchewan.

## **COVER PHOTO CREDITS**

Saskatchewan Ministry of Environment

## **CONTACT**

For more information, please contact Environmental Assessment and Stewardship:

4<sup>th</sup> Floor, 3211 Albert Street

Regina, SK S4S 5W6

Tel.: 306-787-6132

Fax: 306-787-0930

## FOREWORD

This document is a guideline only and is subject to change. In all cases, proponents must ensure that their project complies with all applicable provincial and federal legislative and regulatory requirements. Proponents must ensure that all applicable environmental approvals are identified and obtained before starting construction.

## LIST OF ACRONYMS

| <b><u>Acronym</u></b> | <b><u>Meaning</u></b>                   |
|-----------------------|---|
| AMP                   | Adaptive Management Plan                |
| the Act               | <i>The Environmental Assessment Act</i> |
| BACI                  | Before-After-Control-Impact             |
| CEA                   | Cause and Effect Analysis               |
| the ministry          | Ministry of Environment                 |
| MW                    | megawatt                                |
| SFE                   | Significant Fatality Event              |
| WEP                   | Wind Energy Project                     |

## TABLE OF CONTENTS

|   |     |
|---|-----|
| FOREWORD.....   | II  |
| LIST OF ACRONYMS .....  | III |
| 1.0 INTRODUCTION .....  | 1   |
| 1.1 PURPOSE OF THIS GUIDELINE .....   | 1   |
| 1.2 REGULATORY FRAMEWORK .....  | 2   |
| 2.0 ADAPTIVE MANAGEMENT .....   | 2   |
| 3.0 APPLYING THE MITIGATION HIERARCHY IN AN ADAPTIVE MANAGEMENT CONTEXT .....           | 4   |
| 3.1 MANAGEMENT TRIGGERS .....   | 5   |
| 3.2 MANAGEMENT RESPONSE.....  | 7   |
| 3.3. COMPENSATORY MITIGATION .....  | 8   |
| 4.0 POST-CONSTRUCTION MONITORING AND REPORTING .....                                    | 9   |
| 5.0 OTHER RESOURCES AND CONTACT INFORMATION.....  | 10  |
| APPENDIX A - MANAGEMENT TRIGGERS FOR BIRD AND BAT FATALITY AT WEPS IN SASKATCHEWAN..... | 11  |
| APPENDIX B - POST-CONSTRUCTION MONITORING PROTOCOL AND REPORTING .....                  | 12  |
| REFERENCES.....   | 178 |

The information provided in this guideline has been prepared by the Ministry of Environment with the best available information and input from key stakeholders, the ministry may revise the guidelines in the future as more experience with WEPS in Saskatchewan is gained. For further information, please contact [environmental.assessment@gov.sk.ca](mailto:environmental.assessment@gov.sk.ca), or visit [www.saskatchewan.ca/environmentalassessment](http://www.saskatchewan.ca/environmentalassessment).

## 1.0 INTRODUCTION

In 2015, the Saskatchewan Power Corporation (SaskPower) announced a target of 50 per cent renewable energy generation capacity by 2030 and has subsequently announced plans for future procurements of renewable energy projects in Saskatchewan. In response to the expected influx of wind energy projects (WEPs) being submitted for environmental review, the Ministry of Environment (ministry) released the *Wildlife Siting Guidelines for Saskatchewan Wind Energy Projects* (siting guidelines) in 2016 to provide clarity to proponents regarding expectations for siting of these projects in Saskatchewan. The siting guidelines include designation of avoidance zones where WEPs are considered higher risk to wildlife populations, natural lands or in potential conflict with current land designations (e.g., provincial parks, conservation easements, etc.). The siting guidelines also reference additional guidance the ministry will develop specific to fatality monitoring requirements, adaptive management and mitigation measures.

### 1.1 PURPOSE OF THIS GUIDELINE

The ministry uses a results-based approach for regulating development in Saskatchewan, which focuses on achieving positive environmental outcomes rather than a highly prescriptive, command and control style of regulation. The outcomes the ministry intends to achieve through the development of these guidelines and regulation of WEPs include:

- providing regulatory clarity and transparency to support responsible wind energy development and operations in Saskatchewan;
- supporting sound science-based management, and ensuring wildlife and habitat impacts resulting from wind development are satisfactorily avoided, minimized and offset, so as to meet compliance requirements;
- providing effective protection for species at risk;
- improved understanding of the impacts of wind energy projects in Saskatchewan; and
- evaluation and continuous improvement of mitigation approaches to manage development effects on wild species and habitat over time.

The ministry has prepared this document to complement the siting guidelines and to support effective adaptive management of commercial-scale WEPs. Proper siting of WEPs is a critical first step in avoiding potential impacts to wildlife and their habitat.

This document outlines standards and principles for adaptive management of WEPs to support sound evaluation of wildlife and habitat impacts, and foster continuous improvement of mitigation approaches over time. It includes: standards for post-construction monitoring; triggers for reporting and management action in response to observed impacts; and general guidance on compensatory mitigation should it be required.

## 1.2 REGULATORY FRAMEWORK

The guidance document aligns with the ministry's transition to a results-based regulatory approach that enables acceptable development to proceed in balance with conservation and sustainable use of natural resources.

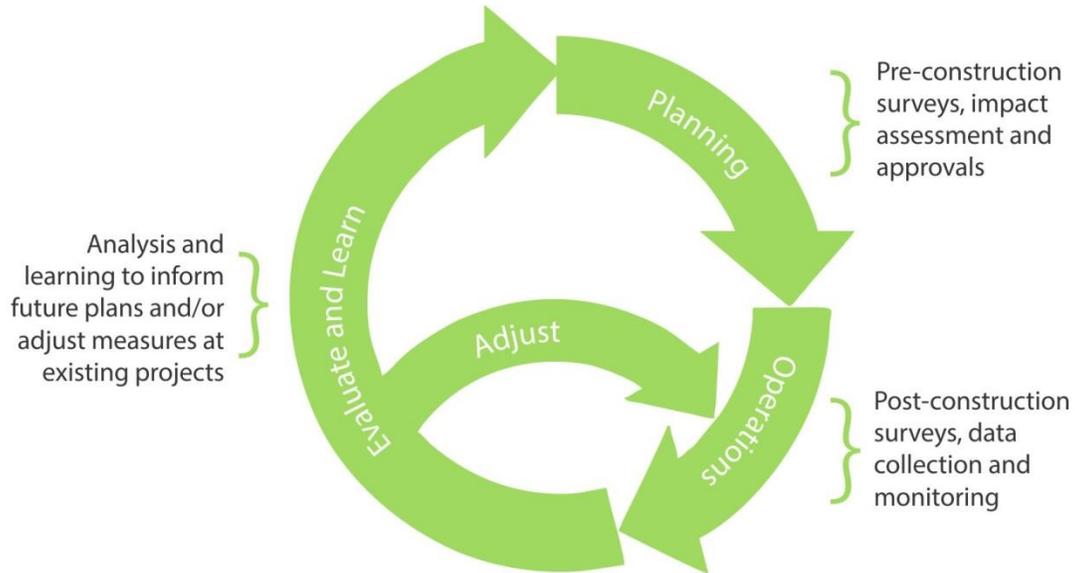
Wildlife and their habitats are protected in Saskatchewan under a combination of provincial and federal legislation including *The Environmental Management and Protection Act, 2010*, *The Environmental Assessment Act*, *The Wildlife Act, 1998*, *The Wildlife Habitat Protection Act*, *The Water Security Agency Act*, the federal *Species at Risk Act*, *Canadian Environmental Protection Act*, *Fisheries Act*, and *Migratory Birds Convention Act*. Regulations pursuant to the *Migratory Birds Convention Act* provide for the conservation of migratory birds and the protection of their nests and eggs. Additionally, the *Species at Risk Act* prohibits the killing, harming or harassing of listed species, the damage or destruction of their residences, and the destruction of critical habitat. Proponents must comply with all applicable legislation at all times. The ministry or other agencies responsible for the legislation may exercise their powers of enforcement in situations of non-compliance.

## 2.0 ADAPTIVE MANAGEMENT

Adaptive management (AM) is a systematic science-based process intended to improve policies and practices by learning from the outcome of management decisions and to reduce scientific uncertainty. There is no widely accepted definition of AM for wind energy, but AM has been defined and broadly applied in other natural resource settings. The ministry has considered the approach originally developed by the US Department of Interior and adopted by the International Energy Agency in its Wind Adaptive Management White Paper (2016).

AM is a deliberate, iterative process driven by management questions that focus on data collection and analysis. It allows for adaptability in monitoring, management actions based on observed outcomes, and utilizes feedback from assessment of WEP design and operation to inform future management and enhance understanding of the

system being managed. As illustrated in Figure 1, AM is often depicted as a cycle of planning, operation and monitoring, evaluation of results, and adjusting operations as required to continually improve environmental performance and minimize project impacts.



**Figure 1: Adaptive Management Cycle (after Hanna *et al.*, Adaptive Management White Paper (2016))**

For individual WEPs, the expectation is that AM would be applied at the project scale to: assess the effectiveness of the site-specific mitigation strategies devised during pre-project planning; identify appropriate management responses or adjustments of operations to address unforeseen impacts; and inform and improve longer term mitigation strategies going forward. The ministry will require proponents of WEPs to prepare a detailed Adaptive Management Plan (AMP) for review and approval as part of the technical proposal and/or environmental impact statement during the environmental assessment review process. The AMP will describe:

- the initial suite of operational mitigation strategies to be implemented and evaluated;
- key uncertainties for analysis;
- the monitoring and evaluation plan; and
- responses to be taken in the event mitigation strategies do not perform as expected.

The AMP should integrate recommended monitoring methodologies, management triggers and responses, and seek to adhere to guiding principles for mitigation discussed

in Section 3.0. The AMP should also include other measures deemed necessary by the proponent based on project-specific details, emerging technology or as a result of improved understanding of potential impacts of WEPs.

The AM cycle begins with pre-project planning and assessment of potential impacts including appropriate [pre-construction surveys](#) to assess wildlife species presence and to identify any local environmental sensitivities. This assessment is a key basis for the identification of initial mitigations to be integrated in project design and operation.

Post-construction surveys and monitoring of WEPs is a critical component of the cycle. Effective adaptation or adjustments can only be achieved where current and accurate information is available to inform the process. The standard minimum post-construction monitoring cycle will include monitoring for the first two years of operation, and again on the fifth and tenth years of operation. Monitoring conducted on years five and ten will be scoped to project-specific issues, conservation objectives or species of concern in a given location and will include clearly defined measurements for success. When developing the AMP, proponents should consider site-specific factors or issues identified during project planning to ensure the monitoring plan can adequately assess the effectiveness of mitigations or identify additional management actions that are required. Minimum standard requirements for the monitoring of WEPs are discussed in Section 4.0 and in detail in Appendix B.

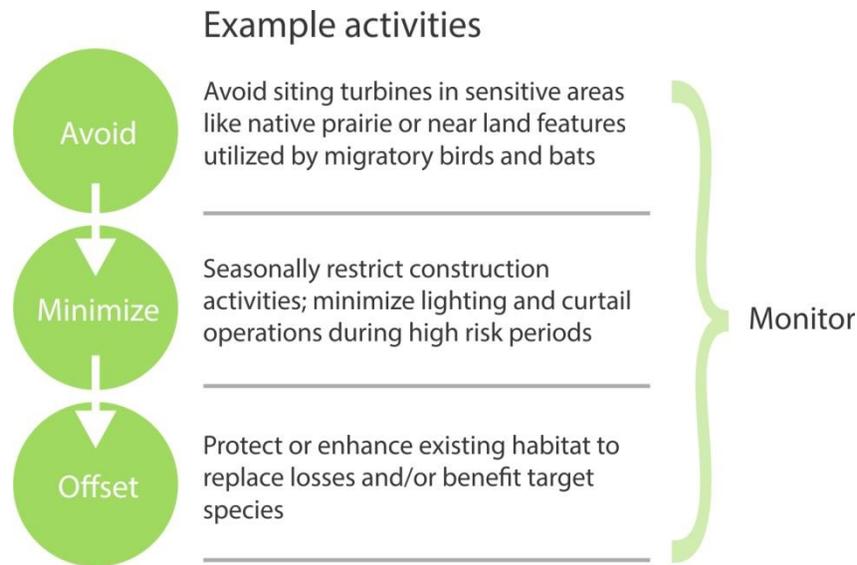
Evaluation of monitoring results and/or a cause-and-effect analysis (CEA) by proponents and the ministry will inform decisions on the need for subsequent adjustments to the mitigation plan and future monitoring and reporting needs. Based on the outcomes of monitoring, assessment frequency may be reduced or mitigations or operational adjustments may no longer be required should alternative effective mitigation options become available.

The AM cycle will also include a review of a WEP's AMP with results from the monitoring conducted in years five and ten: to ensure information in the AM plan is current; includes all viable options for mitigation of impacts; and reflects the improved understanding of the impacts of the facility.

### **3.0 APPLYING THE MITIGATION HIERARCHY IN AN ADAPTIVE MANAGEMENT CONTEXT**

Mitigation is a step-by-step approach to avoid and minimize impacts, and if necessary, compensate or offset impacts that are not adequately reduced (Figure 2). For WEPs, the greatest opportunity for avoidance occurs during the pre-project planning phase.

Mitigation efforts are expected to consist mainly of actions to minimize, and where necessary, offset unavoidable effects during construction, operation and decommissioning.



**Figure 2: The mitigation hierarchy (after Hanna *et al.*, Adaptive Management White Paper (2016))**

WEPs have the potential to cause two main types of impacts on wildlife: impacts on habitat (e.g. outright conversion of native habitat, displacement impacts) and direct impacts on individual organisms causing fatality or reduced survival from collisions, barotrauma, etc. It is not the purpose of this guideline to prescribe universal mitigation solutions for the full range of potential impacts of WEPs on wildlife and habitat. As part of Technical Proposals and AMPs, proponents are expected to develop their own strategies tailored to the site-specific risks of the individual project for assessment and approval by the ministry.

Since fatalities may have the potential to impact populations of some species, and may occur despite thorough planning by the proponent, the ministry has established management triggers (Appendix A) to guide responses to fatality events. This is intended to provide assurance to proponents as to the potential for mitigation and reporting required in response to fatality conditions. In some cases, compensatory mitigation or offsets may be required. A further description of these management triggers and responses, as well as general guidance for compensatory mitigation, is provided below.

### 3.1 MANAGEMENT TRIGGERS

Management triggers have been established using best available information and consider the following:

- legal status or conservation objectives for species;
- mortality thresholds utilized in other Canadian jurisdictions;
- monitoring data from the [Wind Energy Bird & Bat Monitoring Database](#);
- passerine fatality data published in Erickson *et al.*, 2014; and
- science-based information regarding species biology, as well as population status and trends.

Management triggers are structured in a tiered fashion (Tier 1, 2 and 3) with different monitoring and reporting requirements for events falling within each range (Appendix A). The triggers align with a risk-based approach that considers the likelihood and severity of potential impacts for individual species or groups of species, provides a mechanism for the ministry to manage WEP performance, and initiates a discussion between proponents and the ministry about the need for additional mitigation to reduce impacts of the facility.

One of the primary considerations used for establishment of management triggers was legal status or conservation objectives, where available, for individual species. Species with varying status under the Committee on the Status of Endangered Wildlife in Canada, *Species at Risk Act*, *The Wildlife Act, 1998* or conservation ranking by the Saskatchewan Conservation Data Centre have been assigned to different management ranges. No fatality of listed species is permitted within the management ranges. The ministry will require proponents to report fatality and/or injury of any listed species within 24 hours of observation or the next business day.

All birds and bats, except those listed in Section 4(1) of the *Wildlife Regulations* (Saskatchewan), which may be impacted by WEP operations are protected under provincial and federal law. To achieve compliance and avoid potential legal liabilities and risks it is important to monitor for fatality events and implement appropriate management responses to respond to impacts on listed and non-listed species. Management triggers have been established for non-listed bird species (excluding raptors), non-listed raptors and non-listed bats based on fatality observed at operating Alberta facilities as presented in *Wind Energy Bird and Bat Monitoring Database: Summary of the Findings from Post-construction Monitoring Reports* (BSC, 2016), as well as data presented in *A Comprehensive Analysis of Small-Passerine Fatalities from Collision with Turbines at Wind Energy Facilities* (Erickson *et al.*, 2014). Data from Alberta WEPs was used because of similarities with Saskatchewan in geography, climate and species ranges. Management trigger values are represented as an annual fatality

rate per megawatt (after an estimator has been applied). Management triggers will not include bird species listed under Section 4(1) of *The Wildlife Regulations*. Fatality of bird species listed in Section 4(1) of *The Wildlife Regulations* must be reported separately but will not be used in determining management trigger values.

In addition, significant fatality events (SFE) have been defined based on existing guidance in Ontario and modified to include SFEs for bats (uses observed/actual, uncorrected fatality). Research presented in Frick et al., 2017 suggests that migratory bat fatalities resulting from WEPs in North America may already have population-level impacts on hoary bats. The ministry has based the management triggers for bats on fatality data from WEPs operating in Alberta (BSC, 2016) to account for the level of risk and likelihood of significant impacts to some bat species.

The ministry will continue to assess fatality levels as more WEPs move into operation as part of an adaptive regulatory approach and may consider revising the management triggers as more information and experience is collected and as a result of research into population levels of both birds and bats in Saskatchewan. Management triggers are outlined in Appendix A.

### 3.2 MANAGEMENT RESPONSE

Wind energy-related fatality levels for management triggers are defined in this guideline; however, the resulting management responses are provided as examples only. Specific requirements for management responses will be determined on a case-by-case basis in discussion between the ministry and proponents and will depend on the results of the CEA, as required. CEA is utilized in other jurisdictions following a significant fatality event or when a management trigger has been met or exceeded.

The CEA considers the seasonality, geography, weather, habitat type and other environmental conditions that may have contributed to higher than expected fatality levels.

The ministry will consider a range of mitigation options commensurate with the scale and severity of fatality events at the WEP as guided by the established management ranges. Mitigation measures that have been applied as a result of fatality events may need to be evaluated for effectiveness in reducing impacts to birds and bats through ongoing monitoring. Further adjustments to the mitigation program will be required if monitoring shows that mitigation measures are not effective in reducing bird and bat fatality.

If monitoring results indicate continuing very low fatalities, there is potential for the monitoring program and/or adaptive management cycle to continue at a reduced frequency or be discontinued altogether.

### 3.3. COMPENSATORY MITIGATION

In cases where impacts of WEPs to habitat or wildlife cannot be avoided or minimized through appropriate siting and/or through other mitigation strategies included in the AMP, the ministry may require compensatory mitigation to offset the overall impacts of the project.

Habitat effects may be compensated for or offset through restoration and enhancement of an appropriate amount and quality of 'replacement' habitat. Various offset approaches have been developed in different jurisdictions and are useful for reference (Hanna *et al.*, 2016). Environment and Climate Change Canada's *Operational Framework for Use of Conservation Allowances* and the Department of Fisheries and Oceans *Fisheries Productivity Investment Policy* are two examples. The ministry is also in the process of developing and testing habitat mitigation guides for wetlands and native prairie to assist proponents in devising offset strategies where their operations result in unavoidable impacts on these habitat types.

Direct offsetting for unavoidable species fatalities is more challenging. Compensatory approaches to mitigate wildlife fatalities at wind facilities have not been widely tested or evaluated. Potential conservation measures for bats could include preservation and provision of roosts, creation of open water, or forest management beneficial to the affected species. For birds, protecting or enhancing feeding and providing breeding or roosting habitat for target species could theoretically increase survival of local populations. However the empirical basis to estimate how much of any given habitat conservation measure is needed to offset fatality is scarce. This underscores the importance of avoiding and minimizing fatalities through alternative approaches that have been shown to be effective (e.g. operational adjustments during high-risk periods).

Alternatively, proponents could devise strategies to offset unavoidable fatalities of affected species at WEPs through actions that reduce fatalities due to other causes such as electrocutions or collisions with existing transmission lines. The ministry may explore options with proponents as a potential means to manage unavoidable effects.

Ministry expectations for compensatory mitigation or offsets as a means to address habitat impacts or incidental mortalities at WEPs follow broadly accepted mitigation standards and principles. The ministry's draft mitigation framework outlines these in more detail. Adherence to these principles is likely to aid in the development of a

successful offset plan. The ministry will consult with WEP companies to devise a mutually-acceptable compensation plan where required.

#### 4.0 POST-CONSTRUCTION MONITORING AND REPORTING

The intent of post-construction monitoring of WEPs is to assess impacts of their operation. A key risk is bird and bat collision with turbines and other associated infrastructure. The focus of this section is to provide proponents with guidance on the detection of bird and bat casualties resulting from the operation of turbines at WEPs. Indirect effects, such as avoidance of the project area by wildlife, can also impact populations, especially for species at risk. Where a WEP is approved for siting within sensitive habitats such as native prairie, post-construction population surveys may also be required to compare impacts relative to pre-construction surveys.

Despite best attempts to site WEPs in order to avoid risks to wildlife and follow best practices in design, construction and operation, some level of bird and bat fatalities will likely occur. The ministry has established a standardized post-construction monitoring protocol (Appendix B) which is intended to provide consistency in post-construction monitoring. The ministry will consider site-specific factors and proponent commitments to implement proactive measures to prevent fatality and may reduce post-construction monitoring requirements when the situation warrants, as part of an adaptive and flexible regulatory approach for WEPs. Additional information about monitoring and reporting requirements can be found in Appendix B.

For wind energy projects constructed in phases, monitoring for each phase should commence with its start-up. Information gathered can be used to evaluate possible impacts on wildlife from successive phases and inform design changes or additional mitigation measures that may be effective.

The ministry recognizes that costs to conduct monitoring can be substantial. However the information it provides is an essential input for adaptive management of individual WEPs and for the evolution of the ministry's regulatory approach over time. Co-operative arrangements among Saskatchewan WEP proponents could enhance consistency and effectiveness of monitoring, reduce costs, and aid in developing and communicating management solutions. The ministry is prepared to explore these options with proponents and partners as one potential way to minimize environmental compliance costs and enable better approaches.

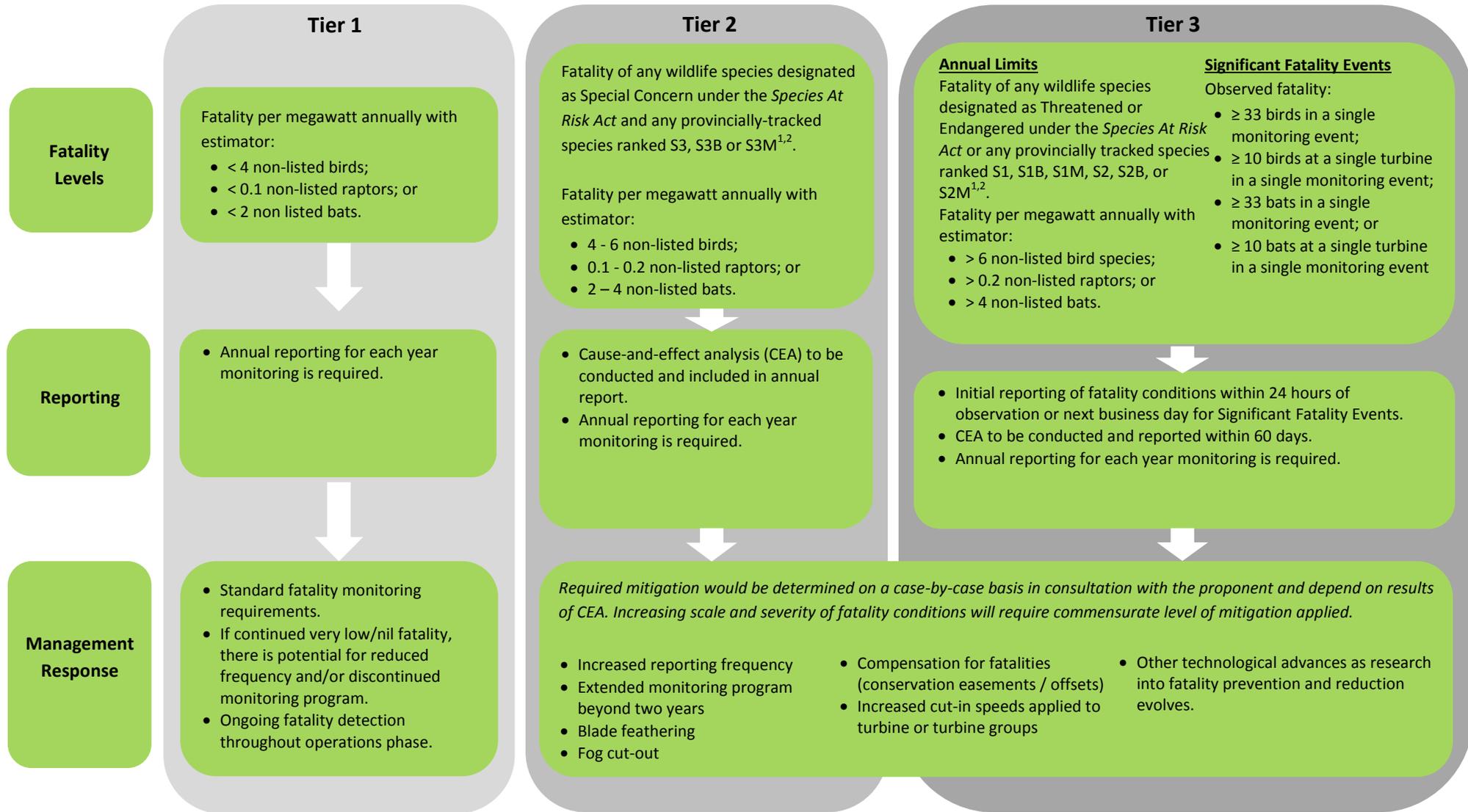
## 5.0 OTHER RESOURCES AND CONTACT INFORMATION

Proponents are advised to contact the ministry for further explanation and clarification of any uncertainties regarding the information provided in this document. Proponents will also benefit from review of other resource materials concerning environmental assessment in Saskatchewan at [www.saskatchewan.ca/environmentalassessment](http://www.saskatchewan.ca/environmentalassessment).

Ministry staff and other officials are available to advise on any matters related to environmental requirements for wind energy projects in Saskatchewan. For further information, please contact:

Manager - Applications  
Environmental Assessment and Stewardship Branch  
4<sup>th</sup> Floor, 3211 Albert Street  
Regina, SK S4S 5W6  
Tel.: 306-787-6132  
Fax: 306-787-0930  
Email: [environmental.assessment@gov.sk.ca](mailto:environmental.assessment@gov.sk.ca)

## APPENDIX A - MANAGEMENT TRIGGERS FOR BIRD AND BAT FATALITY AT WEPS IN SASKATCHEWAN



- In cases where the provincial and federal rankings differ, the federal designation must be used to determine the appropriate Tier
- In cases where the provincial ranking contains two or more rankings (e.g. S2M, S1B), the ranking with the lowest number must be used to determine the appropriate Tier.
  - For example, if a bird was ranked S3B, S2M then it would be considered to have an S2 ranking and therefore included in Tier 3. Provincial ranking information can be found at: [www.biodiversity.sk.ca/SppList.htm](http://www.biodiversity.sk.ca/SppList.htm) (provincial rankings are contained in the field marked Subnational Rank). This list will be updated frequently as species are reassessed, the most up-to-date copy should be used.
- Annual fatality triggers are after an estimator for carcass removal and searcher efficiency has been applied as part of the fatality monitoring analysis.
- Annual fatality triggers do not include bird species listed in Section 4(1) of *The Wildlife Regulations*.
- Significant fatality event numbers are observed fatality and do not have an estimator applied.

## **APPENDIX B - POST-CONSTRUCTION MONITORING PROTOCOL AND REPORTING**

The following post-construction monitoring protocol describes the requirements for post-construction surveys and minimum standards for survey duration, extent, area, timing and frequency, and has been based, in part, on the *Wildlife Directive for Alberta Wind Energy Projects* (Government of Alberta, 2017). Guidance is also provided for reporting and qualifications for personnel. Additional requirements may be required by the ministry based on site-specific considerations.

### **Types of Surveys Required**

Proponents must submit an AMP that includes their proposed monitoring plan as part of the technical proposal and/or environmental impact statement. The monitoring plan must include a minimum of three standard components: 1) Casualty Survey to identify post-construction casualties; 2) Carcass Removal Trials and; 3) Searcher Efficiency Trials. The latter two components provide estimators for scavenged and missed carcasses that improve the calculation of fatality estimates. An estimator for the proportion of the 65 metre radius actually searched also needs to be included when calculating the corrected fatality estimate (see Corrected Fatality Estimates below). Where projects are likely to impact sensitive species or have been sited in sensitive areas as described in the *Wildlife Siting Guidelines for Saskatchewan Wind Energy Projects*, monitoring for indirect impacts, such as avoidance of the project area, may be required. Indirect impacts monitoring may include Before-After-Control-Impact studies (BACI) or other population monitoring surveys as determined by the ministry on a case-specific basis. This guideline will not address indirect impact studies, but only the first three standard survey components for direct impacts.

In addition to the above mentioned surveys it is expected that proponents will include ongoing fatality detection throughout operation (i.e. during infrastructure maintenance). Specifically, this operational fatality detection would include written documentation of incidental fatalities (see point 10. under “Reporting”) encountered during visits to the site and reporting incidents of species at risk fatality or significant fatality events as per Sections 3.1, 3.2 and Appendix A. When possible, carcasses must be identified to species-level and digital photos of each carcass must be taken. Carcasses may be in deteriorated condition that would not allow for identification but all reasonable efforts to identify should be taken.

|                             | Casualty Survey   | Carcass Removal Trial  | Searcher Efficiency Trial   |
|-----------------------------|---|--|---|
| <b>Purpose</b>              | <ul style="list-style-type: none"> <li>Casualty surveys are employed to identify specific species, periods of high fatality, or turbines/turbine groups linked to fatality. This knowledge can be used to identify and scope subsequent monitoring, evaluate the success of mitigation measures (i.e., siting), establish protocols for operational mitigation and inform adaptive management.</li> </ul>   | <ul style="list-style-type: none"> <li>Scavenger removal trials are designed to determine the per cent of casualties that are taken from the survey area by scavengers.</li> </ul>   | <ul style="list-style-type: none"> <li>Searcher efficiency trials are designed to assess the percentage of carcasses found by searchers in different habitats.</li> </ul>   |
| <b>Duration</b>             | <ul style="list-style-type: none"> <li>Following the post-construction monitoring protocol for a minimum of two consecutive years after operation of the site or phase begins; and</li> <li>Scoped monitoring program (see Section 2.0) on years five and ten of operation to inform the adaptive management plan*.</li> </ul> <p>*The ministry may approve reduced frequency or discontinuation of monitoring if fatalities remain consistently low to negligible.</p>   | <ul style="list-style-type: none"> <li>Continues as long as the fatality monitoring program is required.</li> </ul>  | <ul style="list-style-type: none"> <li>Continues as long as the fatality monitoring program is required.</li> </ul>   |
| <b>Areal Extent – Scope</b> | <ul style="list-style-type: none"> <li>All turbines where a site has <math>\leq 10</math> turbines.</li> <li>30 per cent of turbines (minimum of 10 turbines) which represent all habitats (including habitats likely to support species at risk) and spatial locations (edge, middle, etc.). All turbines should be classified according to their habitat type prior to choosing representative turbines. Habitat type classes can be considered a treatment group as defined in the <a href="#">Wind Energy Bird and Bat Monitoring Database</a>. Adaptive mitigation would potentially apply to all turbines in a similar site type.</li> <li>Half the height of the turbine from blade tip to ground or a 65 metre radius, whichever is greater.</li> </ul> | <ul style="list-style-type: none"> <li>At least one turbine in each habitat type from the subset of turbines used for Casualty Surveys.</li> <li>Randomly place 10 carcasses (fresh or thawed) per visibility class (i.e., easy, moderate, difficult), with a maximum of three carcasses per turbine.</li> </ul> | <ul style="list-style-type: none"> <li>At least one turbine in each habitat type from the subset of turbines used for Casualty Surveys.</li> <li>Randomly place 20 carcasses (fresh or thawed), distributed across the habitat types and substrates (gravel, grass, shrub, etc.), but with a maximum of three carcasses per turbine.</li> </ul> |
| <b>Survey Methods</b>       | <ul style="list-style-type: none"> <li>Equally spaced transects set five metres apart.</li> <li>Average length of time monitoring each turbine to be reported.</li> </ul>   | <ul style="list-style-type: none"> <li>Equally spaced transects set five metres apart.</li> <li>Average length of time monitoring each turbine to be reported.</li> </ul>  | <ul style="list-style-type: none"> <li>Equally spaced transects set five metres apart.</li> <li>Average length of time monitoring each turbine to be reported.</li> </ul>   |

|                                 | Casualty Survey  | Carcass Removal Trial   | Searcher Efficiency Trial  |
|---------------------------------|--|---|--|
| <b>Frequency</b>                | <ul style="list-style-type: none"> <li>Once weekly, minimum of seven day interval.</li> </ul>  | <ul style="list-style-type: none"> <li>Check each carcass during the once weekly Casualty Surveys.</li> </ul>   | <ul style="list-style-type: none"> <li>Carry out during the once weekly Casualty Surveys.</li> </ul>   |
| <b>Time of Year</b>             | <ul style="list-style-type: none"> <li>Between April 1 to October 31, 8 weeks of monitoring during the spring period and 10 weeks of monitoring during the fall period.</li> </ul>   | <ul style="list-style-type: none"> <li>Conduct trials once in each search season (spring, summer, and fall) or annually.</li> </ul>   | <ul style="list-style-type: none"> <li>Conduct trials once in each search season (spring, summer, fall).</li> </ul>  |
| <b>Time of Day</b>              | <ul style="list-style-type: none"> <li>One hour after sunrise to one hour before sunset.</li> </ul>  | <ul style="list-style-type: none"> <li>One hour after sunrise to one hour before sunset.</li> </ul>   | <ul style="list-style-type: none"> <li>One hour after sunrise to one hour before sunset.</li> </ul>  |
| <b>Environmental Conditions</b> | <ul style="list-style-type: none"> <li>A light breeze creates feather flutter for easier detection.</li> <li>Avoid rain which flattens feathers.</li> <li>Avoid extremely windy conditions which move vegetation and obscure carcasses.</li> </ul> | <ul style="list-style-type: none"> <li>A light breeze creates feather flutter for easier detection.</li> <li>Avoid rain which flattens feathers.</li> <li>Avoid extremely windy conditions which move vegetation and obscure carcasses.</li> </ul>  | <ul style="list-style-type: none"> <li>A light breeze creates feather flutter for easier detection.</li> <li>Avoid rain which flattens feathers.</li> <li>Avoid extremely windy conditions which move vegetation and obscure carcasses.</li> </ul>   |
| <b>Search Effort</b>            | <ul style="list-style-type: none"> <li>The same turbines must be sampled at each monitoring interval and each year.</li> </ul>   | <ul style="list-style-type: none"> <li>Carcasses should be left until gone or the 20 day trial period ends.</li> </ul>  | <ul style="list-style-type: none"> <li>N/A</li> </ul>  |
| <b>Other Considerations</b>     | <ul style="list-style-type: none"> <li>N/A</li> </ul>  | <ul style="list-style-type: none"> <li>Use gloves to place carcasses to prevent human scent from attracting scavengers.</li> <li>Bats, small brown birds or small mammal carcasses should be used.</li> <li>Locations of carcasses need to be marked with a GPS and discretely marked to distinguish them from turbine casualties.</li> </ul> | <ul style="list-style-type: none"> <li>Searchers should not be aware of the trial to limit bias; i.e., trials should be blind.</li> <li>Bats, small brown birds or small mammal carcasses should be used.</li> <li>Locations of carcasses need to be marked with a GPS and discretely marked to distinguish them from turbine casualties and to avoid searcher bias resulting from visual clues.</li> <li>Efficiency is affected by topography, vegetation, weather, lighting and carcass decomposition. Trials are to be conducted for each searcher or team and efficiency calculated as the number of carcasses detected relative to the number placed in each trial period.</li> </ul> |

## Calculation of Fatality Estimates

The ministry will adopt the methodology and formulas referenced in *An Estimator of Wildlife Fatality from Observed Carcasses* (Huso, 2011), and will require that all WEPs follow this approach as a minimum standard. For consistency, the Huso estimator will be used to compare fatality conditions at WEPs across Saskatchewan; however the ministry may consider other estimators that may be more relevant to site-specific conditions prior to considering the need for management responses.

## Personnel Requirements

All surveys and analyses should be designed and managed by biologists trained in bird and bat identification and who are familiar with the habitats and species that will be encountered throughout the site. For standard carcass searches, well-trained technicians and possibly search dogs can be employed under the supervision of the qualified biologist. Where specific species detection survey protocols exist, the personnel requirements set out in those protocols must be met.

## Permitting

A [Research Permit](#) application must be completed and submitted to the ministry in order to conduct pre- and post-construction surveys for plants and wildlife and to collect carcasses. When conducting BACI or other population surveys, Species Detection Survey Protocols must be followed where applicable. In cases where Species Detection Survey Protocols exist, the ministry may consider alternate methodologies that are as rigorous as the prescribed protocol. To request the use of an alternate method or to submit a Species Detection Survey Protocol for approval, please complete the Species Detection Application form in addition to the Species Detection Survey Protocol Template.

## Reporting

Monitoring results, including incidental observations, must be submitted using the [Wind Energy Bird and Bat Monitoring Post-Construction Loadform](#) to the ministry at [ENV.researchpermit@gov.sk.ca](mailto:ENV.researchpermit@gov.sk.ca) in accordance with the Research Permit submission requirements contained on the ministry's Species Detection webpage. All pre- and post-construction monitoring information will be forwarded for inclusion in Bird Studies Canada's national [Wind Energy Bird and Bat Monitoring Database](#). The database is a confidential environment that enables data analysis to improve understanding of wind energy impacts across the country. For more information and to view a summary report on past analyses, visit the Wind Energy Bird and Bat Monitoring Database webpage.

Significant fatality events (defined in Appendix A) or fatality of any listed species must be reported to the ministry within 24 hours of observation or next business day.

In addition to completing and submitting the information required under the Research Permit, proponents are required to submit results from fatality monitoring in a report to the Environmental Assessment and Stewardship Branch by February 1 of the following year when post-construction monitoring is required as per section 2.0. More frequent reporting may be required depending on fatality conditions.

Each report should contain:

|   |
|---|
| 1. Methodology and rationale for any ministry-approved deviations from this guidance document.  |
| 2. Description of any turbine habitat type classes and identification of representative monitoring turbines. Turbine habitat type classes can be considered equivalent to Treatment Groups as defined in the <a href="#">Wind Energy Bird and Bat Monitoring Database</a> .   |
| 3. Results of Carcass Removal Trials and Searcher Efficiency Trials.  |
| 4. Calculation of the carcass removal and searcher efficiency using the Huso estimator.   |
| 5. Corrected, summarized fatality rate for: <ul style="list-style-type: none"> <li>a. non-raptor birds per turbine and per MW, by season (April-May, June-July, August-October) and by year;</li> <li>b. raptors per turbine and per MW, by season and by year;</li> <li>c. bats per turbine and per MW, by season and by year; and</li> <li>d. Corrected, summarized fatality rate excludes bird species listed in Section 4(1) of the <i>Wildlife Regulations</i>.</li> </ul> |
| 6. Results of any BACI studies or other population surveys that may have been required.   |
| 7. GIS shapefile indicating which turbines are being monitored and GPS locations of the individuals detected in the Casualty Surveys.   |
| 8. Digital photograph of each carcass found in Casualty Surveys in situ.  |
| 9. Digital copy of the monitoring data that was submitted to <a href="mailto:ENV.researchpermit@gov.sk.ca">ENV.researchpermit@gov.sk.ca</a> in accordance with the Research Permit submission requirements.   |

10. Casualty Survey data per monitoring event per turbine including:
  - a. turbine number and location;
  - b. date and time the turbine is surveyed;
  - c. weather conditions, including wind strength and direction;
  - d. vegetation surrounding the turbine;
  - e. observer identity (consistent name or number for each observer); and
  - f. for each individual detected record:
    - i. location (UTM coordinates);
    - ii. species;
    - iii. sex;
    - iv. age class (if apparent);
    - v. state of decomposition; and
    - vi. apparent injuries and signs of scavenging.

### Carcass Submission

All carcasses found, either through casualty searches or incidentally, should be labelled according to reporting requirements 10.f) above. Carcasses may be used for Carcass Removal and Searcher Efficiency Trials or handled according to the [Conservation Standards Terms and Conditions](#).

### Injured/Dead Birds and Bats

Unless authorized under the Research Permit, notification must be provided to the nearest Compliance and Field Services (CFS) Office if any species protected under *The Wildlife Act, 1998*:

- a. is found injured or dead within the project footprint or study area;
- b. requires euthanasia; or
- c. requires transportation to a veterinarian or rehabilitation facility;

Any carcass that is suspected of having a disease is to be submitted to the Canadian Wildlife Health Cooperative. Bird or bat carcasses that are not used in trials must be submitted to the Royal Saskatchewan Museum in Regina (contact: 306-787-2801 to arrange drop off or pick up). Carcasses must also be sealed in double plastic bags and frozen. Casualties and carcasses that are submitted must have a label with the Research Permit number, location, date and collector's name.

## REFERENCES

- Alberta Environment and Parks, 2017. Wildlife Directive for Alberta Wind Energy Projects. Government of Alberta.
- Barclay, R., Baerwald, E., 2015. Post-Construction Wind Energy Protocol for Bats. University of Calgary.
- Bird Studies Canada, Canadian Wind Energy Association, Environment Canada and Ontario Ministry of Natural Resources 2016. Wind Energy Bird and Bat Monitoring Database Summary of the Findings from Post-Construction Monitoring Reports.
- Erickson, W.P., Wolfe, M.M., Bay, K.J., Johnson, D.H. and Gehring, J.L. 2014. A Comprehensive Analysis of Small-Passerine Fatalities from Collision with Turbines at Wind Energy Facilities. PLoS ONE 9(9): e107491.  
<https://doi.org/10.1371/journal.pone.0107491>
- Frick, W.F., Baerwald, E.F., Pollock, J.F., Barclay, R.M.R., Szymanski, J.A., Weller, T.J., Russell, A.L., Loeb, S.C., Medellin, R.A., McGuire, L.P. 2017. Fatalities At Wind Turbines May Threaten Population Viability Of A Migratory Bat. *Biological Conservation*, 209.  
<https://doi.org/10.1016/j.biocon.2017.02.023>.
- Huso, M. 2011. An estimator of wildlife fatality from observed carcasses. *Environmentrics*, 22, 318-329.
- Hanna, L., Copping, A., Geerlofs, S., Feinberg, L.; Brown-Saracino, J., Gilman, P., Bennet, F., May, R., Köppel, J., Bulling, L., Gartman, V. 2016. Assessing Environmental Effects (WREN): Adaptive Management White Paper. Report by Berlin Institute of Technology, Bureau of Ocean Energy Management (BOEM), Marine Scotland Science, Norwegian Institute for Nature Research (NINA), Pacific Northwest National Laboratory (PNNL), and US Department of Energy (DOE). 46.