For Direction at the June 30 – July 2, 2009
U.S. Fish and Wildlife Service
Wind Turbine Guidelines Advisory Committee Meeting

Packet of Materials

- Cover Memo from the Synthesis Workgroup to the Reader
- Draft Cover Letter to the Secretary of the Interior *(to be written)*
- Draft Table of Contents
- Committee Draft Policy Recommendations
- Committee Draft v.3 Recommended Guidelines

June 11, 2009

TO: Readers of USFWS Wind Turbine Guidelines Advisory Committee Public Packet

FR: USFWS Wind Turbine Guidelines Advisory Committee Synthesis Workgroup, or Drafting Subcommittee

RE: Background and Explanation of Draft v.3

DT: June 11, 2009

The USFWS Wind Turbine Guidelines Advisory Committee (Committee) has been working diligently for 1.5 years to produce a recommendation to the Secretary of the Interior.

The attached *Draft v.3* is a draft to be discussed by the Committee and then modified. This is not a consensus draft. There are important policy, technical, and editorial issues yet to be addressed. Once the Committee has discussed the draft at the June 30 - July 2, 2009 meeting, it will be edited based on Committee direction.

Committee members are beginning to develop a list of policy, technical, and editorial items to discuss further at the next Committee meeting from June 30 - July 2, 2009. This initial list is noted below:

- ***Policy-Related Items to be Addressed by the Committee at the June 30 - July 2, 2009 Meeting***

Section II of Draft v.3 Committee Draft Policy Recommendations and Language

- Review all policy recommendations (including the order of policies).
- Review policy recommendation on addressing the impacts to wildlife from other stressors, including climate change.
- Review use of the word “streamline.”
- Cumulative Impacts Analysis and Cumulative Effects: this section is being revised.

Section III of Draft v.3 Committee Draft Guidelines (Guidelines)

Chapter One

- **NEPA Compliance:** does use or application of the Guidelines support NEPA compliance?

Chapter Two

- **Recommend voluntary guidelines?**
- **Adaptive Management:** Do we have the right description regarding how adaptive management is reflected in the Tiered Approach?

Chapter Three

- **Level of detail in Tiers 1-5:** the Committee will discuss and confirm that the Science & Tools Subcommittee is taking the right approach with the level of detail contained in the methods and metrics.
- **Tier 1 - Early Coordination:** Revisit how Tier 1 is written, with particular attention to *when* the developer actually selects a site and how and whether to include in the Guidelines the sequence of activities a developer goes through prior to talking with agency staff.
- **Tier 1 - Landscape/habitat level review:** have we adequately addressed this issue?
- **Tier 3 - Field studies to document site wildlife conditions:** should the Guidelines be more specific about which wildlife and wildlife populations the developer is responsible for studying?
- **Tier 3 - Prescriptive (vs. descriptive) in Tiers 3, 4, and 5**
  - A basic question for the Guidelines is: what is the appropriate level of detail and specificity for each of the Tiers, and how prescriptive should the Guidelines be?
  - Factors to think about include:
    - The Guidelines need to apply to 50 states
    - They need to allow for a range of flexibility to address local conditions
    - They are written to reflect what is needed to best describe and address risk at each of the tiers, but not necessarily to prescribe one specific method (since different methods are more or less useful depending on local habitat and species conditions)
- **Tier 3 - Minimum standards:** consider including these, i.e. when is impact minimization sufficient; what is an acceptable level of impact; what amount of information is adequate to determine anticipated level of impact?
- **Tier 5 - Curtailment Studies**: where should these be included in the Guidelines and in the development process?
- **Tier 5 -** How to approach Tier 5 in general (Science & Tools is reviewing)
- **Triggers**
  - The Guidelines need to clarify thresholds, or trigger points, which will require better articulated off-ramps for terminating projects (i.e. what information determines when to decide to abandon a project, move to a different tier, or permit/construct).
- **BMPs:** Are the BMPs sufficient as written; are there any additional BMPs needed? Any to delete?

Chapter Four

- **Mitigation**
  - The goal of Chapter Three of the Guidelines is to recommend effective measures to avoid or minimize impacts to wildlife. Chapter Four focuses on the third element of mitigation, "compensatory mitigation." The draft needs to make this distinction clearer through its presentation of the material and the language used.

- What level of impact is acceptable, when is mitigation recommended, and how much impact is too much?

Chapters Five - Seven

- **Chapter Five, Section C – USFWS-State Coordination and Cooperation**: At the federal level, the Guidelines are not recommending regulation. Revisit the description of delegation to states and consistency of application.
- **Chapter 5, Section E - USFWS-Developer Coordination and Cooperation:** What constitutes "compliance" with the Guidelines?
- **Chapter 5, Section G – NGO Actions:** this section is a placeholder.

➢ ***Overall Technical Questions Regarding Draft v.3***

- The Science & Tools Subcommittee is evaluating the Methods and Metrics section of the draft for accuracy and completeness, and may bring issues to the Committee for its consideration. The technical edits being reviewed include, for example, modifications to the flow chart describing the tiered approach, the definition of terms, protocols related to lighting, buffers, survey and monitoring protocols (intervals and tools), etc.

➢ ***Overall Editorial Changes To Be Made to Draft v.3***

- **Organization of Chapters:** In a subsequent draft it may be desirable to modify the chapters, particularly Five, Six, and Seven.
- **Citations:** Add sources and consistency. Include references to recent studies that are currently missing so that the document reflects the most up-to-date information.
- **Distinction of Roles:** The Guidelines need to be clearer on who is being addressed in each section.
- **Glossary:** A thorough review of the definitions will be needed between Drafts v.3 and v.4.
- **Appendices**: At the January 2009 meeting, the Committee agreed to make all appendices part of the final consensus Draft. The Committee will need to conduct a thorough review of all appendices.

Cover Letter from the Committee to the Secretary of the Interior, *to be inserted*

U.S. Fish and Wildlife Service
Wind Turbine Guidelines Advisory Committee

Draft Table of Contents

I. <u>Preamble to the Committee Draft Recommendations</u>

A. Wind Turbine Guidelines Advisory Committee (Committee) Established to Provide Recommendations on Siting Wind Development Projects

In response to interest in development of windpower in the United States, the U.S. Fish and Wildlife Service (USFWS) released in July 2003 for public comment a set of voluntary, interim guidelines for developing wind power projects. After USFWS reviewed the public comments, the Secretary of the Interior (Secretary) established a Federal Advisory Committee to provide recommendations to avoid or minimize impacts to wildlife and their habitats related to land-based wind energy facilities. In March of 2007, USFWS announced the establishment of the Committee in the *Federal Register*.

Pursuant to the requirements of the Federal Advisory Committee Act (FACA), the Committee Charter was signed by the Secretary on October 26, 2007, and is effective for two years. The Charter states the Committee’s scope and objective:

The Committee will provide advice and recommendations to the Secretary of the Interior (Secretary) on developing effective measures to avoid or minimize impacts to wildlife and their habitats related to land-based wind energy facilities.” (See Attachment X for full Charter)

The attached Recommended Guidelines (Guidelines) are the result of two years of deliberation by the Committee. Committee Members represent a balance of stakeholder groups with the necessary policy, technical, and/or scientific expertise to address minimization of wildlife impacts associated with the development of the Nation’s wind power potential. Committee Members were carefully selected by the Secretary from a large pool of candidates.

Committee Members

Taber Allison, Massachusetts Audubon Society
Ed Arnett, Bat Conservation International
Michael Azeka, AES Wind Generation
Kathy Boydston, Texas Parks and Wildlife Department
René Braud, Horizon Wind Energy
Scott Darling, Vermont Fish & Wildlife Department
Mike Daulton, National Audubon Society
Aimee Delach, Defenders of Wildlife
Karen Douglas, California Energy Commission
Greg Hueckel, Washington Department of Fish & Wildlife

Jeri Lawrence, Blackfeet Nation
Steve Lindenberg, U.S. Department of Energy
Andrew Linehan, Iberdrola Renewables
Rob Manes, The Nature Conservancy, Kansas
Winifred Perkins, Next Era Energy
Steve Quarles, Crowell & Moring, LLP
Rich Rayhill, Ridgeline Energy, LLC
Robert Robel, Kansas State University
Keith Sexson, Kansas Department of Wildlife & Parks
Mark Sinclair, Clean Energy Group
Dave Stout, U.S. Fish & Wildlife Service
Patrick Traylor, Hogan & Hartson, LLP

B. Background on Context and Need for the Recommended Guidelines

Wind development in the United States increased by 46%[1] in 2007, and at the end of 2007 the United States had the second highest cumulative wind capacity globally. This rate of development is expected to continue, and perhaps to accelerate, as United States energy policy emphasizes independence from foreign oil and reduction of carbon emissions. USFWS and the Committee Members recognize that wind-generated electrical energy is renewable, and is considered to be a generally environmentally-friendly technology.

Wind energy produces electricity without air pollution, greenhouse gas emissions, water consumption, mining, drilling, refining, waste storage and other problems associated with many traditional forms of energy generation. Wind power has recently received increased attention because it is a domestic source of energy, and because carbon dioxide emissions from fossil fuel combustion is the leading cause of anthropogenic climate change, which is likely to have serious negative impacts on ecosystems and wildlife.[2] The U.S. Department of Energy (DOE) estimates that a single 1.5 MW wind turbine displaces 2700 metric tons of CO^2 per year compared with the current U.S. average utility fuel mix.[3] Due to these advantages, wind is expected to play an increasingly important role in meeting the Nation's energy goals in the coming years.

Nevertheless, as the U.S. moves to expand wind energy production, it also must maintain and protect the Nation's wildlife and habitats, which wind energy production can negatively affect. With proper diligence to siting, operations and management, it is possible for facilities to avoid, minimize and mitigate these impacts. As with all responsible energy development, wind power facilities should adhere to high standards for environmental protection.

C. Premises and Guiding Principles Under Which the Committee Operated

[1] (20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply. (2008).248 pp; NREL Report No. TP-500-41869; DOE/GO-102008-2567).
[2] Intergovernmental Panel on Climate Change 2007
[3] 20% Wind Energy by 2030 2008).

Committee Premises

- Acknowledging the USFWS definition of wildlife (see glossary); recognition that different species and species groups have different levels of protection under tribal, federal and state wildlife statutes. (See Legal White Paper).

- Identify, evaluate and recommend approaches to assessing risk and impacts to wildlife associated with wind energy development that are useful regardless of the regulatory status of any particular species, and that are particularly focused on those species most likely to be affected by wind energy development.

- Recognition that, among different wind energy projects, there will be varying degrees of potential impact to wildlife as well as varying degrees of certainty associated with the assessments of that potential impact. Thus varying levels of effort will be appropriate in assessing the risk of potential projects and how or whether the projects are developed

- Recognition that it is possible and essential to avoid, minimize, and/or mitigate negative impacts on wildlife populations and habitats while balancing expected impacts with the costs of undertaking necessary studies and monitoring.

Committee Guiding Principles for the Guidelines

- Provide a consistent methodology for conducting pre-construction risk assessments and post-construction impact assessments to guide siting decisions by developers and agencies

- Encourage communication and coordination between the developer and relevant state and federal agencies during all phases of wind energy project development

- Provide mechanisms to encourage their adoption and use by all federal agencies, as well as the wind energy industry, while recognizing the primary role of the lead agency in coordinating specific project assessments

- Complement state and tribal efforts to address wind/wildlife interactions and provide a voluntary means for these entities to coordinate and standardize review of wind projects with the USFWS

- Provide a clear and consistent approach that increases predictability and reduces the risk of liability exposure under federal wildlife laws

- Provide sufficient flexibility to accommodate the diverse geographic and habitat features of different wind development sites

- Present mechanisms for determining compensatory mitigation, when appropriate, in the event of unforeseen impacts to wildlife during construction or operation of a wind energy project

- Define scientifically rigorous and cost-effective study designs that improve the ability to predict direct and indirect wildlife impacts locally and regionally

- Include a formal mechanism for revision in order to incorporate experience, technological improvements, and scientific advances that reduce uncertainty in the interactions between wind energy and wildlife

II. Committee Draft Policy Recommendations

Adoption and Use of the Guidelines

Adopt, promulgate, and consistently implement the voluntary Guidelines recommended in this document. The Committee gave considerable attention to the production of a suggested protocol for wildlife assessment and siting decisions at wind power facilities. This protocol, described in detail in Chapter 3 of this document, uses a tiered approach to evaluate, predict, and minimize the risk of potential wind projects to wildlife and habitat, and to assess and mitigate impacts post-construction. The Committee believes that the final product reflects a comprehensive and user-friendly risk assessment and decision-making tool that supports Department of the Interior's (DOI) priorities with respect to renewable energy development, federal and state trust responsibilities, developer cost and confidentiality concerns, and the needs of sensitive wildlife and habitats, without creating new regulations. The Committee recommends that the Secretary direct USFWS to promptly adopt the recommended voluntary Guidelines developed by the Committee.

In adopting and implementing the Guidelines, the Committee recommends that the Secretary use the premises and principles adopted by the Committee, as set forth in Section I.C. above.

Tools and Support for Implementation

Develop landscape tools and provide analysis to assist in implementation of the Guidelines. An important aspect of the tiered risk assessment process is that it encourages the use of existing landscape and habitat mapping data to provide a rapid early assessment of the potential wildlife and habitat risk of a site or region. In order to facilitate this process for the developer, the Committee recommends that the Secretary instruct USFWS to investigate existing on-going landscape analysis and mapping efforts focused on renewable energy. USFWS should determine if these processes provide timely and adequate geographic and/or habitat and species information associated with wind energy development. USFWS should also seek opportunities to coordinate its own related processes, and/or supplement these activities to provide a landscape-level habitat and ecosystem mapping tool that will be useful for improving wind energy siting. The Committee also recommends that USFWS staff assist in the analysis and interpretation of these tools to further facilitate the process.

Provide and/or support adequate, meaningful incentives for industry's voluntary adoption of the Guidelines. The Committee has explored a suite of legal and financial incentives to encourage universal adoption of the recommended voluntary guidelines. The results of these investigations are described in detail in Chapter 5 of the Guidelines. The Committee recommends that DOI implement incentives within DOI's purview simultaneously with promulgation of the Guidelines. The Committee also recommends that DOI engage constructively to support potential incentives that are outside the purview of DOI (for instance those that would require statutory changes) and encourage their timely adoption and implementation.

Advance the use, cooperation, and effective implementation of the Guidelines. Coordinate within DOI and with other federal agencies, tribes, states, wind developers and other stakeholders to maximize the use and effectiveness of the Guidelines. In order to do this, the Committee recommends the Secretary consider the following:

- Encourage collaboration and coordination with other federal and state agencies and tribes to streamline and encourage consistent review of wind energy projects.
- Develop best management practices based on the Guidelines.
- Promote use of the Guidelines by federal and state agencies, as well as by the private sector.
- Provide training to USFWS and other federal agency field personnel on effective use of the Guidelines.
- Streamline the review and permitting process for wind projects by federal agencies.
- Advance the involvement and cooperation of non-governmental organizations with an interest in improving siting and compensatory mitigation for wind projects.

Assure that the USFWS has an adequate budget and staff resources to implement the Guidelines as necessary, including training of Regional and Field staff and other interested stakeholders.

When making policy decisions, address both the threat to birds and other wildlife from climate change, and the effects of other stressors. The Secretary is encouraged to make management, policy, project-specific assessment, siting, and mitigation decisions, with appropriate consideration of wind energy's air pollution, greenhouse gas, water consumption, and other benefits, when conducting its review of wind energy development pursuant to the Guidelines. According to the USFWS Climate Change Strategic Plan (Strategic Plan), "Climate change is the greatest challenge the Service has ever faced in conserving fish, wildlife and their habitats." The Strategic Plan outlines a joint commitment to *mitigation*[4] (reducing the sources or enhancing the sinks or carbon dioxide) and *adaptation*[4] (management to reduce the impacts of climate change on fish, wildlife and habitats). The Committee urges the Secretary to hold both of these commitments in mind when making management decisions related to wind development: recognizing both the important role that wind power, as a carbon-free energy source, will play in climate change *mitigation*[4], while also delivering wind on the landscape in a manner that supports wildlife *adaptation*[4] to climate change, namely by minimizing wind's potential to itself be a non-climate stressor.

[4] As defined by the Intergovernmental Panel on Climate Change (IPCC).

Future Application

Research. Work with other federal agencies, stakeholders, and states to develop a national research plan that identifies and implements research priorities to reduce impacts to wildlife resources while allowing wind energy development. Research should be conducted collaboratively, wherever possible, and should include appropriate stakeholders and peer review.

Revise the Guidelines. Review and revise the Guidelines, as justified, at least once every five years to incorporate new knowledge on wildlife interactions with wind energy and the rapidly advancing technology of commercialized wind energy production. The Secretary should use the Committee's premises and principles to assist in revisions of the Guidelines.

Use an approach as consistent with these Guidelines as appropriate when reviewing off-shore wind energy development. Other guidelines should be developed for wind projects near-shore and on the Outer Continental Shelf. Off-shore wind projects may use different survey methods, but the tiered approach can be used to determine site development potential and identify potential natural resource issues.

Cumulative Effects Analysis. The Committee recommends DOI improve its capability to assess cumulative impacts by working with the USFWS Regions to undertake, subject to available resources, a comprehensive look at the range of development stressors at an ecoregion level, that looks at indicator species or habitats within the ecoregion at the most risk of significant effects from wind development, in conjunction with other reasonably foreseeable development pressures. As part of this process, USFWS should engage with wind industry and other stakeholders to estimate, if feasible, the effects that full build out of wind energy might have on those species or habitats within an ecoregion.

Therefore, the Committee recommends that each region of the USFWS develop a cumulative effects analysis with the goal of identifying species and habitats at particular risk from the cumulative effects of wind energy and other types of development. The product of regional analyses of cumulative effects should be available to inform Tier 1 preliminary site assessment or Tier 2 site characterization as well as for designing Tier 3 wildlife surveys.[5]

[5] The Committee also recommends that in developing the scope of this cumulative effects analysis, the USFWS review the conclusions of the white paper on cumulative effects analysis developed by the USFWS, Oregon Department of Fish and Wildlife, and other stakeholders during the development of the Oregon Columbia Ecoregion Wind Energy Siting and Permitting Guidelines (September 29, 2008). The white paper reviewed multistate cumulative effects analyses prepared by WEST, Inc. in the Pacific Northwest and made recommendations on how such analyses could be more effective. Recommendations included:

- Collaborative funding and management of regional cumulative effects analysis
- Focus on a limited number of key regional indicator species and habitats most likely to be affected by wind energy
- Studies to better understand the population dynamics of the key indicator species and to develop "impact levels of concern"
- Development of an action plan for impacts to key species and habitats that are above "threshold of concern" levels

U.S. Fish and Wildlife Service
Wind Turbine Guidelines Advisory Committee

Draft Recommended Guidelines

Submitted to the Secretary of the Interior
(Date)

By the Wind Turbine Guidelines Advisory Committee

U.S. Fish and Wildlife Service
Wind Turbine Guidelines Advisory Committee

Draft Recommended Guidelines

Draft Table of Contents

Chapter Five: Advancing Use, Cooperation, and Effective Implementation of the Guidelines

A. Recommendations from the Legal and Incentives Subcommittees on Incentives for Use of the Guidelines (*currently being drafted)*

B. Federal Interagency coordination and cooperation

C. USFWS-state coordination and cooperation

D. USFWS-tribal coordination and cooperation

E. USFWS-developer coordination and cooperation (*currently being drafted)*

F, Use of Avian and Bat Protection Plan

G. NGO Actions

Chapter Six: Revisions to the Guidelines

Chapter Seven: Recommendations for Effective USFWS Administration of the Guidelines

A. Consistent application

B. Training

C. Staff support

D. Research

Appendices - *incomplete*

Please see the FAC website for the Other Models Subcommittee Matrix from October 21-23, 2008: *www.fws.gov/habitatconservation/windpower/wind_turbine_advisory_committee.html*

A. WTGAC Legal Subcommittee White Paper October 21-23, 2008

B. WTGAC Landscape/Habitat Subcommittee, "Mapping Tools Case Studies" October 21-23, 2008

C. WTGAC Landscape/Habitat Subcommittee, Summary of Metadata for Data Layers Mapped, October 21-23, 2008

D. WTGAC Existing Guidelines Subcommittee Recommendations, October 21-23, 2008

E. First Draft Recommended Elements of an Avian and Bat Protection Plan, October 21-23, 2008

F. Glossary

Bibliography

Draft Recommended Guidelines

Executive Summary, ***to be inserted***

Chapter One: Introduction

A. Background

In response to the Nation's growing demand for production of electricity by wind power and in recognition of the U.S. Fish and Wildlife Service (USFWS) mission "Working with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people," the Secretary of the Interior (Secretary) authorized USFWS to charter the Wind Turbine Guidelines Advisory Committee (Committee) to recommend effective measures to avoid or minimize impacts to wildlife and their habitats related to land-based wind energy facilities.

Herein are the Committee's Recommended Guidelines (Guidelines) based on two years of deliberations and judgments regarding the siting and operation of large wind developments while minimizing impacts to wildlife and their habitat. The Committee is composed of a broad array of representatives selected for their outstanding experience on these issues, and who are among the most informed in the country. These Guidelines are the Committee's best attempt to present the most effective, feasible, and appropriate approaches that are available to the Department of the Interior (DOI), tribes, states, local jurisdictions, and the wind industry to address USFWS responsibilities to protect wildlife resources while encouraging responsible siting and operation of wind energy projects.

B. Premises and Guiding Principles

In its development of these Guidelines, the Committee accepted by consensus the following premises and principles on March 26, 2009 and recommends these be incorporated into the final guidance published by the USFWS.

Premises

1. The Committee acknowledges the USFWS definition of wildlife (see glossary). The Committee recognizes that different species and species groups have different levels of protection under tribes, federal and state wildlife statutes. (See Legal White Paper).

   It is the Committee's intention to identify, evaluate and recommend approaches to assessing risk and impacts to wildlife associated with wind energy development that are useful regardless of the regulatory status of any particular species, and that are particularly focused on those species most likely to be affected by wind energy development.

2. The Committee recognizes that, among different wind energy projects, there will be varying degrees of potential impact to wildlife as well as varying degrees of certainty

associated with the assessments of that potential impact. Thus varying levels of effort will be appropriate in assessing the risk of potential projects and determining how or whether the projects are developed.

3. The Committee recognizes that it is possible and essential to avoid, minimize, and, if necessary, mitigate negative impacts on wildlife populations and habitats while balancing expected impacts with the costs of undertaking necessary studies and monitoring.

Principles

1. The Guidelines should provide a consistent methodology for conducting pre-construction risk assessments and post-construction impact assessments to guide siting decisions by developers and agencies

2. The Guidelines should encourage communication and coordination between the developer and relevant state and federal agencies during all phases of wind energy project development

3. The Guidelines should provide mechanisms to encourage their adoption and use by all federal agencies, as well as the wind energy industry, while recognizing the primary role of the lead agency in coordinating specific project assessments

4. The Guidelines should complement state and tribal efforts to address wind/wildlife interactions and provide a voluntary means for these entities to coordinate and standardize review of wind projects with the USFWS

5. The Guidelines should provide a clear and consistent approach that increases predictability and reduces the risk of liability exposure under federal wildlife laws

6. The Guidelines should provide sufficient flexibility to accommodate the diverse geographic and habitat features of different wind development sites

7. The Guidelines should present mechanisms for determining compensatory mitigation, when appropriate, in the event of unforeseen impacts to wildlife during construction or operation of a wind energy project

8. The Guidelines should define scientifically rigorous and cost-effective study designs that improve the ability to predict direct and indirect wildlife impacts locally and regionally

9. The Guidelines should include a formal mechanism for revision in order to incorporate experience, technological improvements, and scientific advances that reduce uncertainty in the interactions between wind energy and wildlife

C. Benefits of Using the Guidelines

As our Nation moves to achieve its renewable energy commitments, it must also maintain and protect its wildlife resources. The Committee's Guidelines will facilitate wind energy development while protecting wildlife and their habitat. The Guidelines will provide best management practices for wind energy-wildlife interactions and result in greater regulatory certainty for the wind developer by:

1. **Reduced Ecological Impacts**
   The Guidelines offer a science-based reference for use by industry, federal, state, tribal and local agencies, and other stakeholders in the siting and permitting of wind projects. The Guidelines describe the kind of information needed to adequately identify, assess, minimize, mitigate, and monitor the wind-wildlife impacts when developing new wind energy projects and repowering existing facilities. The Guidelines will promote scientifically sound, cost-effective study designs; produce comparable data among studies throughout the Nation; allow for analyses of trends and patterns of impacts at multiple sites; and ultimately improve the ability to estimate and resolve impacts to wildlife and habitats locally and regionally.

2. **Increased Compliance and Reduced Regulatory Risk**
   The Guidelines are a tool for facilitating compliance with relevant laws and regulations by recommending methods for conducting site-specific, scientifically sound biological evaluations. Following the Guidelines supports National Environmental Policy Act (NEPA) compliance, facilitates permit review, and provides a measure of regulatory certainty for wind energy developers. Using the methods described in the Guidelines will provide information for impact assessment, minimizing impacts, and compensatory mitigation (if needed) for the application of wildlife protection laws. It also demonstrates a good faith effort to develop and operate wind projects consistent with the intent of local, state, and federal laws.

3. **Improved Predictability of Wildlife and Habitat Impact**
   The goal of the Guidelines is to provide a consistent, predictable approach to assessing impacts to wildlife and habitats from wind energy projects, while providing flexibility to accommodate the unique circumstances of each project. As comparable information from projects using consistent and standardized methods and protocols becomes available from projects around the Nation, meta-analysis will continue to provide information that allows better predictive modeling. The growing body of information will assist in providing valuable information on "use" of wind energy sites by and potential impacts to birds and bats. Over time the growing knowledge base should decrease the need for some monitoring studies.

4. **Cost Savings**
   The Guidelines recommended herein will promote scientifically sound, cost-effective study designs; produce comparable data among studies within the nation; allow for analyses of trends and patterns of impacts at multiple sites; and ultimately improve the ability to predict and resolve impacts locally, regionally and nationally. This will reduce the need for some studies, thereby reducing project costs. Initiating pre-construction surveys early will help to avoid unnecessary and costly delays during permitting. The

Guidelines advise that the costs and the resulting benefits be considered when developing the monitoring efforts needed for each project site. Some monitoring methods and/or technologies are expensive and should only be recommended when necessary.

Chapter Two: Summary of the Guidelines and General Considerations

A. Intended Use of the Guidelines

Rather than promulgate new regulations, these Guidelines are intended to be voluntary. Although voluntary, the Guidelines described in this report are designed to be used by all prospective developers of wind energy projects and USFWS field staff reviewing such projects. The Guidelines also are intended to provide a useful, suggested approach for local, state and tribal officials, and other interested stakeholders.

The primary purpose of these Guidelines is to describe the information typically needed to identify, assess, and monitor the potential adverse effects of wind energy projects on wildlife and their habitat, especially migratory birds, bats and species at risk, in order to:

- Guide the wind energy industry to make the best possible choices on the location, design and operation of wind energy installations to avoid and minimize the risks to wildlife and their habitat.

- Ensure that the responsible regulatory agency or advisory agency for any wind energy installation is aware of and considers the appropriate factors that present risks to wildlife and their habitat and the full range of options to avoid, minimize and, if needed, provide compensatory mitigation.

- Specify the types and amount of baseline information that are required for adequate review of a wind project; and describe the likely extent of follow-up that would be necessary after construction.

Other purposes include:

- To promote responsible development of wind facilities across the country;

- To enable states, tribes, USFWS, developers and stakeholders to share information and data regarding avian and bat studies, compensatory mitigation options, siting practices, and monitoring of habitat/species impacts, to increase understanding of risks and the effectiveness of siting and operating decision-making;

- To develop effective, consistent and cost-effective methods and protocols to guide project-specific studies, to improve assessment of risk and impacts by producing comparable data; and

- To allow for comparison among field studies from around the country.

The Committee wrote the Guidelines to be as specific as possible with regard to the expectations, recommendations, and appropriate assessments for developing a wind energy project. They must, however, apply to a large diversity of projects in many different habitats. The Guidelines are intended to provide flexibility in their application, in consideration of project specific factors, and not be rigidly applied in every situation.

B. Use of Mitigation Policies and Principles

These Guidelines contain scientifically valid, economic, and technically feasible and effective methods and metrics intended to evaluate risk and estimate impacts to wildlife, inform permitting decisions, and satisfy environmental assessment processes. The objective is to avoid or minimize impacts to fish, wildlife and their habitats, and to provide compensatory mitigation for those impacts not avoided or minimized. Wind project proponents should consider the use of the USFWS Mitigation Policy (USFWS Mitigation Policy, 46 FR 7656 (1981)) whenever it is not possible or feasible to avoid and minimize impacts to wildlife habitats. The USFWS policy provides a common basis for determining how and when to use different compensatory mitigation strategies, and facilitates earlier consideration of wildlife values in wind project planning. The fundamental principles that will guide the use of compensatory mitigation and recommendations by the USFWS are reflected in Chapter 4 of these Guidelines. Wind developers also should consult with appropriate state agencies to ensure compliance with state compensatory mitigation requirements.

C. Introduction to the Decision Framework Using a Tiered Approach

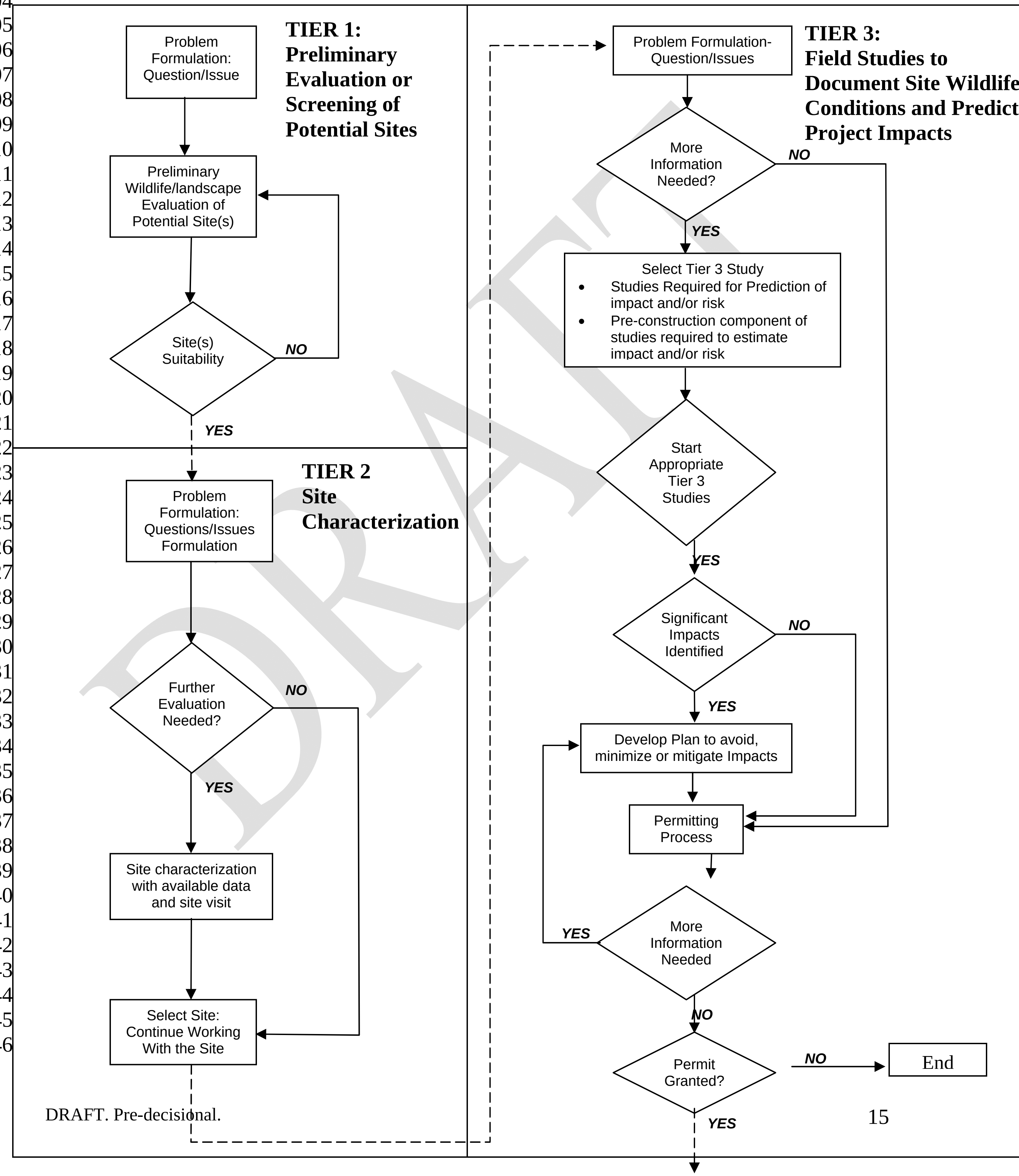
The Committee recommends using a tiered approach to evaluate and minimize the risk of potential wind projects to wildlife (see flow chart below, “General Framework for Minimizing Impacts of Wind Development on Wildlife in the Context of the Siting and Development of Wind Power, October 21-23, 2008”). The tiered approach is a decision framework for collecting information in increasing detail to evaluate risk and make siting and operational decisions. The tiered approach provides the opportunity for evaluation and decision-making at each tier, enabling a developer to abandon or proceed with project development, or to collect additional information if required. This approach does not require that every tier, or every element within each tier, be implemented for every project. Instead, it allows efficient use of developer and wildlife agency resources with increasing levels of effort until sufficient information and the desired precision is acquired for the risk assessment.

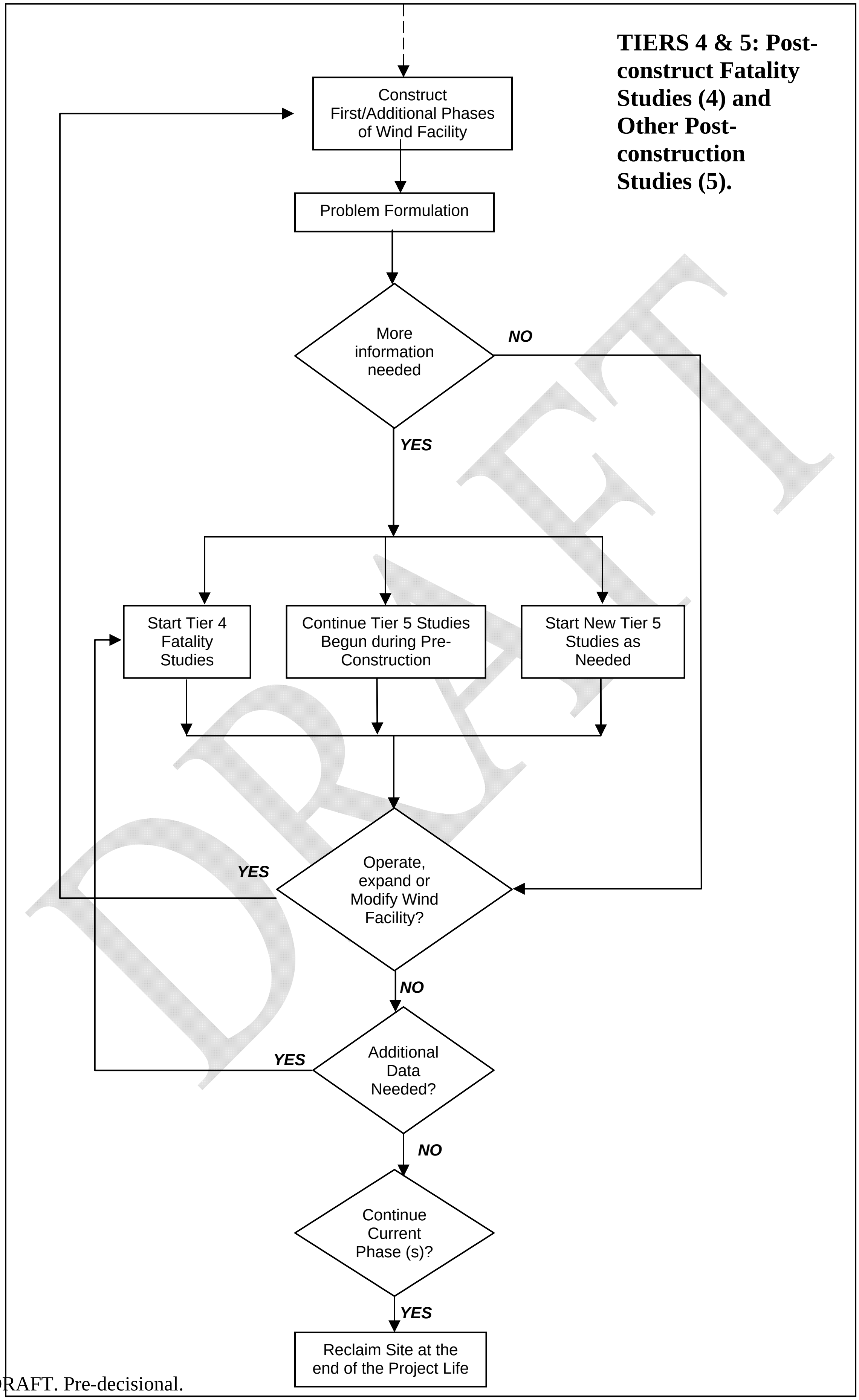
1. Application of the tiered approach and possible outcomes

Five tiers comprise the preconstruction risk assessment and post-construction impact assessment phases of a wind project. Tiers 1-3 are pre-construction activities and are typically sequential investigations. Tiers 4-5 are post-construction activities that may occur simultaneously.

The tiered approach is an iterative process for quantifying the risks to wildlife of a potential wind energy project. At each tier, problem formulation guides the decision process by describing how to determine the need for additional data collection and the identification of potential problems associated with developing or operating a project. If sufficient data are available at a particular tier, the following outcomes are possible based on analysis of the information gathered: 1) the project is abandoned because the risk is considered unacceptable, 2) the project proceeds in the

General Framework for Minimizing Impact of Wind Development on Wildlife in the Context of the Siting and Development of Wind Power (Appendix E from First Release Draft One-Text)




TIERS 4 & 5: Post-construct Fatality Studies (4) and Other Post-construction Studies (5).
Construct First/Additional Phases of Wind Facility
Problem Formulation
More information needed
NO
YES
Start Tier 4 Fatality Studies
Continue Tier 5 Studies Begun during Pre-Construction
Start New Tier 5 Studies as Needed
YES
Operate, expand or Modify Wind Facility?
NO
YES
Additional Data Needed?
NO
Continue Current Phase (s)?
YES
Reclaim Site at the end of the Project Life

development process without additional data collection, or 3) an action or combination of actions, such as project modification, compensatory mitigation, or specific post-construction monitoring, is indicated. If data are deemed insufficient at a tier, more intensive study is conducted in the subsequent tier until sufficient data are available to make a decision to abandon the project, modify the project, or proceed and expand the project. The tiers are listed as follows:

- ✓ Tier 1 - Preliminary evaluation or screening of potential sites
- ✓ Tier 2 - Site characterization
- ✓ Tier 3 – Field studies to document site wildlife conditions and predict project impacts
- ✓ Tier 4 – Post-construction fatality studies
- ✓ Tier 5 – Other Post-construction Studies

2. Research Questions

Much uncertainty remains about predicting risk and estimating impacts of wind energy development on wildlife. It is in the interests of wind developers and wildlife agencies to improve these assessments to better avoid and minimize the wildlife impacts of wind energy development. The Committee recommends that research that improves predictions of pre-construction risk and estimates of post-construction impacts be a high priority. Research can provide data on operational factors (e.g. wind speed, weather conditions) that are likely to result in fatalities. It could also include studies of cumulative effects of multiple wind projects, or comparisons of different methods for assessing avian and bat activity relevant to predicting risk. Research projects may occur at the same time as project-specific Tier 4 and Tier 5 studies. Research would usually result from collaborative efforts involving appropriate stakeholders, and is not the sole or primary responsibility of any developer.

3. Adaptive Management (AM): Definition of Active versus Passive AM and Applicability of AM to the Decision Framework and Tiered Approach.

Adaptive management (AM) is a series of scientifically driven management actions (within economic and resource constraints) that use monitoring and research results to test competing hypotheses related to management decisions and actions, and apply the resulting information to improve management. AM can be categorized into two types: "passive" and "active" (Walters and Holling 1990, Murray and Marmorek 2003). In passive AM, alternatives are assessed and the management action deemed best is designed and implemented. Monitoring and evaluation then lead to adjustments as necessary. In active AM, managers explicitly recognize that they do not know which activities are best, and then select several alternative activities to design and implement.[6]

Passive AM may be applicable to wind energy development if warranted. The tiered approach employed by these guidelines is in fact a passive AM decision-making process. In the pre-

[6] In active adaptive management, monitoring and evaluation of each alternative helps in deciding which alternative is more effective in meeting objectives, and adjustments to the next round of management decisions can be made based on those lessons. With the possible exception of evaluating project specific mitigation measures, the Committee is not advocating that active AM be implemented at wind energy projects. Active AM may be appropriate if there is a specific research objective that is not project specific, and the Committee recognizes that accomplishing those objectives is outside the decision framework and would involve multiple stakeholders and funding sources.

construction environment, analysis and interpretation of information gathered at a particular tier influences the decision to proceed further with the project or the project assessment. If the project is constructed, information gathered in the pre-construction assessment guides possible project modifications, or the need for and design of post-construction studies. Analysis of the results of post construction studies can test design modifications and operational activities to determine their effectiveness in avoiding and minimizing impacts. When there is considerable uncertainty over the appropriate mitigation for a project active adaptive management is the preferred approach to testing the effectiveness of alternative approaches.

For AM to work, there must be agreement to adjust management and/or mitigation measures if monitoring indicates that goals are not met. The agreement should include a timeline for periodic reviews and adjustments as well as a mechanism to consider and implement additional mitigation measures as necessary after the project is developed.

Passive and active AM as described above are similar to the process described in the DOI Adaptive Management Technical Guide (Williams et al 2007). As described in the Technical Guide, AM includes five key elements in its application: stakeholder involvement, management objectives, management alternatives, predictions of the effects of potential management actions, and monitoring protocols and plans. These elements are folded into the structured process of decision making, monitoring, and assessment. Passive AM, and its use in the tiered approach, is consistent with the technique outlined in the Technical Guide.

4. Confidentiality of Site Evaluation Process as Appropriate

Some aspects of the initial pre-construction risk assessment including preliminary screening and site characterization occur early in the development process, when land or other competitive issues limit developers' willingness to share information on the project with the public and competitors. Any consultation should include confidentiality agreements as described earlier in the Guidelines.

5. Cumulative Effects of Project Development

Cumulative effects are the impact on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. The goal of cumulative effects analysis should be to incorporate environmental considerations into the wind energy planning process as early as possible to improve decisions. Without incorporating cumulative effects into planning and management, it will be impossible to move towards development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The magnitude and extent of the effect on a resource depends on whether the cumulative effects exceed the capacity of the resource to sustain itself and remain productive.

Cumulative effects analysis is required by NEPA; any energy project with a federal nexus must include cumulative effects analysis at the appropriate level as part of its NEPA analysis. In that case, developers should coordinate with federal and state resource agencies to assess what other federal, non-federal and private actions are being considered, and which should be included in a cumulative effects analysis. Federal and state agencies are more likely to have information regarding other current and proposed wind development and which species and habitats are at risk from the cumulative effects of wind development.

Where there is no federal nexus, individual developers are not expected to conduct cumulative effects analysis on their own; however, having cumulative effects analysis available would help developers and other stakeholders understand the significance of potential wildlife impacts. Developers are encouraged to coordinate with federal and state agencies early in project development to ensure that the developer is aware of any existing information on the cumulative effects of individual wind projects on species and habitats at risk and incorporates any such info into project wildlife studies.

Chapter Three: The Tiered Approach for Wildlife Assessment and Siting Decisions

The first three tiers describe and recommend studies in the pre-construction phase, and at each of the three tiers a set of questions is listed that the Committee recommends developers attempt to answer for predicting the risk of a potential project. Some of these questions are repeated at each tier. Given the nature of the tiered approach, each additional tier represents a greater investment in data collection, which may be required to answer certain questions. For example, while Tier 1 and 2 investigations may discover some existing information on federally listed species and their use of the proposed development site, it may be necessary to collect empirical data in Tier 3 studies to determine the presence of federally or state-listed species.

A. Tier 1: Preliminary Evaluation or Screening of Potential Sites

For some wind energy projects, the first stage in the assessment of potential risk to wildlife is a preliminary regional evaluation of a potential site or sites in order to identify geographic areas of high wildlife sensitivity due to 1) the presence of large blocks of intact native landscapes, 2) intact ecological communities, 3) fragmentation-sensitive species' habitats, or 4) other important landscape-scale wildlife values. These evaluations rely on geographic databases and generally examine areas from a regional rather than a site-specific scale. Developers who choose to conduct Tier 1 investigations will utilize existing public or other readily available landscape-level maps and databases from sources such as federal, state, or tribal wildlife or natural heritage programs, the academic community, conservation organizations, or the developer's or consultant's own information. The Committee has made a policy recommendation to DOI that USFWS facilitate or participate in the development of a comprehensive landscape database on a national scale for the purpose of identifying and assessing development risks and cumulative impacts to ecosystems and large-scale habitats.

Tier 1 may be used in any of three ways:

a) to identify regions where wind energy development poses exceptional risks to wildlife or habitats, including the fragmentation of large-scale habitats and threats to regional populations of sensitive species;

b) to “screen” an ecoregion or set of multiple potential sites in order to avoid those that have the highest habitat values; or

c) to begin to determine if a single identified potential site poses serious wildlife or habitat concerns.

Tier 1 is considered to be an optional internal process for the developer, and it may not be feasible in all situations. However, Tier 1 is recommended because it offers early guidance about the sensitivity of the site within a larger landscape context, and can help direct development away from sites that will be associated with higher study, mitigation costs, and uncertainty. In some cases, Tier 1 studies could reveal serious concerns indicating that a site should not be developed. In other cases it will raise questions or uncertainties that will guide investigations in further tiers, particularly if the necessary habitat data is deficient or outdated.

Suggested questions to be considered in Tier 1 include:

1. Are there known threatened, endangered, federal "sensitive", state-listed, or other special status species present on the proposed site, and/or is habitat (including designated critical habitat) present for these species?
2. Does the landscape contain any areas of special designation, including, but not limited to, 'area of scientific importance'; 'of significant value'; federally-designated critical habitat; high-priority areas for non-government organizations; or other local, state, regional, federal, tribal, or international categorization that may preclude energy development?
3. Are there known critical areas of wildlife congregation, including, but not limited to, maternity roosts, hibernacula, staging areas, winter ranges, nesting sites, migration stopovers or corridors, leks, or other areas of seasonal importance?
4. Are there large areas of intact habitat with the potential for fragmentation, with respect to species with needs for large contiguous blocks of habitat?

Tier 1 Methods and Metrics

Answers to the above questions may determine whether suitable sites are available in the region where development is being considered and developers can then decide whether to proceed to further tiers (See Tier 2-5 below) as they plan for development of those sites. Developers should review the publicly available data, and the analysis of available sites in the region of interest will be based on a blend of the information available in published and unpublished reports, wildlife range distribution maps, and other such sources.

The purpose of this tier is assist the developer in identifying wind energy development sites with few if any potential conflicts with wildlife. A developer's decision to proceed with further review of potential sites with "yes" answers to any or all of the above questions will entail more detailed studies in Tier 2 and Tier 3 for species considered at risk from the development. "Yes" answers may also result in stronger scrutiny from those state, federal, and tribal agencies that have responsibility for protecting wildlife resources. However, a "Yes" answer to any of the questions does not indicate that a project should not go forward.

While the answer of "no" to the questions where data exists may be encouraging to a developer, an answer of "no" in the absence of data will not necessarily indicate an absence of wildlife conflicts. If a site is selected for further analysis in the absence of data adequate to definitively answer the questions, the developer should attempt to locate the data necessary to answer the questions posed in Tier 2.

B. Tier 2: Site Characterization

At this stage the developer has narrowed consideration down to specific sites, and additional data may be necessary to conduct a more detailed site characterization for a sufficient risk assessment. A distinguishing feature of Tier 2 studies is that they focus on site specific information and should include at least one visit to each of the prospective site(s). Questions suggested for Tier 2 can be answered using credible publicly available information that includes published studies, technical reports, databases, and information from agencies, local conservation organizations, and/or local experts. Developers or consultants working on their behalf should contact the federal, state, tribal, and/or local agencies that have jurisdiction over the potential project.

1. Are threatened, endangered, federal "sensitive", state listed species, or other special status species present on or likely to use the proposed site(s)?
2. Are there rare or unusual plant communities present or likely to be present at the site(s), or plant communities that otherwise have a special designation?
3. Which species of birds and bats, especially those known to be at risk of colliding with wind turbines, are likely to use a proposed site based on an assessment of site attributes?
4. Are there known critical areas of wildlife congregation, including, but not limited to, maternity roosts, hibernacula, staging areas, winter ranges, nesting sites, migration stopovers or corridors, leks, or other areas of seasonal importance associated with the proposed site(s)?
5. Are there large areas of intact habitat with the potential for fragmentation, with respect to species with needs for large contiguous blocks of habitat?

Tier 2 Methods and Metrics

Obtaining answers to Tier 2 questions will involve a more thorough review of the existing site-specific information than in Tier 1. It is expected that the developer will make contact with federal, state, tribal, and/or local agencies that have jurisdiction over the project or information about the potentially affected resources. In addition, because key non-governmental organizations (NGOs) and relevant local groups are often valuable sources of relevant local environmental information, it is recommended that developers contact NGOs, even if the developer is not able to identify specific project location information at this stage due to confidentiality concerns. These contacts also provide an opportunity to identify other potential issues and data not already identified by the developer.

Site visit(s) will normally be conducted to confirm the presence of habitat suitable for species of special interest (e.g., Federal and state listed species, species of conservation concern, species considered at high risk to collisions, etc.), the quality of the habitat, the presence of unique topographic or botanical features and an early indication of the potential for avoidance or mitigation of unavoidable impacts. A sample Site Characterization Study Scope of Work is provided in the Appendix (see attached).

"Yes" answers to any or all of the above questions would indicate potential wildlife conflicts that might preclude or substantially increase the difficulty of wind energy development. Developers should also evaluate whether the data collected from a more detailed site characterization are adequate to evaluate risks to wildlife resulting from the potential wind energy development. For example, do the available data adequately characterize the presence and abundance of wildlife species of interest and their habitat? Furthermore, does information exist that allows the evaluation of risk to the same or similar species? A good source of this information is impact assessments from existing wind facilities operating in similar landscape types.

A developer may decide to abandon the project after Tier 2 analysis, or s/he may decide that potential conflicts can be easily avoided or minimized by the project design. Alternatively, the available data may not be sufficient to characterize the site and/or evaluate risk. If the developer wishes to pursue the potential development of the site then s/he should proceed to the more detailed field studies in Tier 3. The results of the Tier 2 analysis also could indicate, in unique circumstances where wildlife conflicts are low risk, that further studies are unnecessary and the developer can proceed to developing the site.

C. Tier 3: Field Studies to Document Site Wildlife Conditions and Predict Project Impacts

The need for Tier 3 studies should be determined from the results of site characterization at Tier 2. The primary purpose of Tier 3 studies is to provide quantitative data useful in designing a project to avoid and/or minimize risk. They may also allow a pre-construction prediction of risk, and may provide data useful in evaluating predictions of impact and risk through post-construction comparisons of estimated impacts to predicted impacts and risk (i.e., Tier 4 and 5 studies). They are often appropriate for satisfying requirements in permitting or environmental assessments. Tier 3 studies provide information useful in the development of mitigation measures, if needed. The results of these particular Tier 3 studies also may determine that post-construction studies are unnecessary.

1. Do field studies indicate that threatened, endangered, federal "sensitive", state listed species, or other special status species are present on or likely to use the proposed site?
2. Do field studies indicate that there are large areas of intact habitat with the potential for fragmentation that would create significant adverse effects on species with needs for large contiguous blocks of habitat?
3. What is the distribution, relative abundance, behavior, and site use of wildlife determined to be of interest in Tiers 1 or 2, and to what extent do these factors expose these species to risk from the proposed wind power project?

In answering the above questions developers should collect sufficient data to enable analysis that answers the following questions:

4. What are the potential risks of impacts of the proposed wind energy project to individuals and local populations? When necessary due to the presence of rare and/or endangered species, assessment of risk may also include consideration of possible impacts to entire species and their habitats.
5. If significant impacts are predicted, especially to wildlife of interest, can these impacts be avoided, minimized, or mitigated?
6. Are there studies that should be initiated at this stage that would be continued in either Tier 4 or Tier 5?

Tier 3 Methods and Metrics

Tier 3 studies provide pre-construction information that can be used in several ways including:

- Evaluation of a site prior to the final decision to develop;
- The design of a site to avoid or minimize impacts if a decision is made to develop;
- The design of mitigation measures if significant impacts cannot be acceptably avoided or minimized; and,
- As the pre-construction component of Tier 5 studies necessary to estimate impacts.

The recommended Guidelines are designed to be flexible to accommodate local and regional concerns. The decision to conduct a Tier 3 study depends on whether or not additional data are necessary to answer questions of interest. For example, if adequate data are available from nearby sources and/or from studies of the site being evaluated, then additional studies may be unnecessary. Additionally, a reduced level of survey effort may be warranted for certain projects, such as infill development, some repowering projects, or projects contiguous to existing low-impact wind facilities provided these projects have sufficient credible information regarding impacts. When additional studies are warranted, the selected protocols will need to be adjusted to accommodate unique, site-specific conditions such as the species of birds and bats using the site, the frequency and type of bird and bat use, landscape characteristics of the site including terrain and vegetation. The protocol will also need to accommodate the potential for use of pre-construction data in post-construction studies of fatalities (Tier 4) and habitat impacts (Tier 5).

One year of pre-permitting surveys are typically adequate to answer Tier 3 questions. In some cases, depending on the ecosystem type, species and their habitat, the questions to be answered, and availability of existing data, sample design and survey duration and intensity may need to be expanded to include multiple years to account for annual variability. Decisions on the level of survey effort need to be made in discussion with industry, the lead agency, state wildlife agencies, U.S. Fish and Wildlife Service, and local conservation groups as appropriate. One year of pre-permitting surveys are also typically adequate to provide pre-construction data if Tier 4 and 5 studies are contemplated.

The Tier 3 level is the first level in which scientifically rigorous studies may need to be conducted. In most cases we recommend the use of common methods and metrics for understanding wildlife and their habitat, such as bird and bat activity and distribution and the presence of their habitat, at a site and for answering the questions provided at the beginning of Tier 3 discussion. Standard methods and metrics provide great benefit over the long-term, allowing for comparisons among projects (e.g., meta-analysis) and for certainty regarding what will be asked of industry in general for each project. Varying from the standard methods we recommend should be carefully considered, scientifically justified and vetted with the USFWS, the permitting agency, state wildlife agencies and other involved stakeholders.

The specific protocol used in Tier 3 studies depends on the question being addressed. In these Guidelines we do not discuss all the methods and protocols established for specific species, their habitats, and important natural communities. Often threatened and endangered species, species of concern, or those of special interest, and their habitats, have specific protocols required by local, state or federal agencies. The need for special surveys and mapping should be discussed with the appropriate stakeholders in order to address all species and situations adequately. Likewise, Tier 5 studies that require pre-construction data may have specific methods and protocols that go well beyond the Tier 3 studies (e.g., Before-After-Control-Impact (BACI) studies). Even though they begin in Tier 3, these studies are considered Tier 5 studies because they are more complicated, time consuming, and expensive.

The discussion below, therefore, does not always make specific recommendations on duration or frequency of sampling or study design. Instead, scientists experienced with the techniques must design the studies and sampling protocols to the unique features of each site and to the specific questions to be answered.

Many of the methods used to answer Tier 3 questions are areas of active research and worthy of investigation by collaborative, public-private research partnerships with federal and state agencies, wind energy developers and non-governmental organizations interested in wind-wildlife interactions (e.g., Bats and Wind Energy Cooperative; www.batsandwind.org and the Grassland Shrub Steppe Species Cooperative; www.nationalwind.org). While we recommend the use of standard methods we also recognize the need to use the results of this research when existing methods are improved or new methods are developed.

In the past, particular attention has focused on developing methods for predicting collision risk for birds and bats from pre-construction assessments of bird and bat activity. Less attention has been paid to describing direct and indirect impact to wildlife habitat. It is unlikely that a single method can adequately assess this potential collision risk or habitat impact. For example, answering questions regarding nocturnally active species such as migrating passerines and local and migrating passerines are likely to require a combination of remote sensing tools such as marine and NEXRAD radar and indirect inference from diurnal surveys during the migration period. Likewise, answering questions about habitat use by songbirds may be accomplished by relatively small scale observational studies, while answering the same question related to a wide ranging species such as prairie grouse may require more time consuming surveys, perhaps including radio-telemetry.

Below are general questions that should be considered for Tier 3 study. The methods for answering these questions are stated generally, but in some cases greater detail is given regarding more common methods and metrics.

1. **Do field studies indicate that threatened, endangered, federal "sensitive", state listed species, or other special status species are present on or likely to use the proposed site?**

During the problem formulation stage of Tier 1 and/or Tier 2 the specific species that are to be addressed when answering this question should be identified. While the inclusion of state and federal listed species is straightforward, the determination of the “other special-status species” will vary with the site and industry, agency and public concerns. Normally special-status species will include those species proposed for listing by state and federal species protection laws. Raptors, passerines, grouse, bats, and species of high recreational value, such as big game may be included as special-status species as well.

During the problem formulation for Tier 3, a decision should be made as to which species will be studied further in the site assessment. This determination is based on analysis of existing data from Tier 1 and existing data and site visits in Tier 2, and the likelihood of presence and the degree of adverse impact to species or their habitat. Additional analyses should not be necessary if a species is unlikely to be present or is present but impact is unlikely or of minor significance.

For those species selected for further study, a determination of whether field studies are needed is also necessary and this evaluation should be based on the severity of adverse impact and the adequacy of existing data. For example, if the habitat is suitable for a species needing further study and the site occurs within the historical range of the species and/or it is near the existing range of the species but presence has not been documented, additional field studies may be appropriate.

Methods

State and Federal agencies often require specific protocols be followed when listed and special-status species are potentially present on a site. The following discusses some general approaches to determine presence on, and use of a site by listed or special-status wildlife species.

Birds

The methods and protocols for determining threatened, endangered, and other special status bird species presence at a site are normally established for each species and required by federal and state resource agencies. Bird use counts (see question 3 below) will provide presence/absence as a byproduct. Surveys should cover the entire area of interest during seasons when species are most likely present. Normally the methods and protocols by which they are applied also will include an estimate of abundance and more detail is included under question number 3. In general none of these survey methods confirm absence and most presence/absence surveys should be done following a probabilistic sampling protocol to allow statistical extrapolation to the area and time of interest.

Bats

Acoustic monitoring can be a practical method for determining the presence of threatened, endangered or otherwise rare species of bats throughout a proposed wind energy facility (Kunz et al. 2007). Nevertheless, the method requires extensive effort to determine presence of a particular species. Full spectrum time-expansion detectors are the most reliable detectors for identifying species of bats (Kunz et al. 2007). Species identification using zero-crossing technology (i.e., Anabat detectors) is possible for some species (O'Farrell et al. 1999), but is more difficult and controversial for some groups of bats, especially *Myotis* species (Kunz et al. 2007). Sampling for rare species of bats should occur during different seasons and at multiple sampling stations to account for temporal and spatial variability.

While mist-netting bats is required in some situations by state agencies and the USFWS to determine the presence of threatened, endangered or otherwise rare species, we do not recommend mist-netting as a standard method for assessing risk of wind development to bats. Our reasons for this recommendation are detailed below in the discussion of specific bat study methods.

Other Wildlife

Determining the presence of diurnally and/or nocturnally active mammals, reptiles, amphibians, and other species of special interest will typically be accomplished by following agency required protocols. Most listed species have standard protocols for detection (e.g., black-footed ferret). State and federal agencies should be contacted regarding survey protocols for those species of special interest (see Corn and Bury 1990, Olson et al. 1997, Bailey et al. 2004, Graeter et al. 2008 for examples of reptile and amphibian protocols, survey and analytical methods).

2. **Do field studies indicate that there are large areas of intact habitat or the potential for fragmentation of large habitat blocks, with respect to species of special interest with needs for large contiguous blocks of habitat?**

For the purpose of this question habitat fragmentation is defined as the separation of a block of habitat for a species into segments that reduces the genetic and/or demographic viability of the populations surviving in the habitat segments that remain.

The question of fragmentation is relevant as it relates to the habitat for a particular species of interest, the ecology of the species and how fragmentation is defined, as well as for intact expanses of vegetative communities such as wetland and riparian areas. When the characteristics of habitat for a species is well known the habitat can be mapped using existing information (e.g., data, maps, GIS layers, aerial photography) including vegetation, topography, unique habitat features, land use, and species distribution (both existing and historic). The aerial expanse or uniqueness of the habitat or vegetative community must be based on similar information for a much larger geographic area and perhaps the entire historical range of a particular species or expanse of a vegetative community. When the characteristics of habitat of a species is poorly understood or when the use of a particular area as habitat is uncertain, surveys of species use using the same methods described for estimation of risk (e.g., spatially distributed point counts) are appropriate.

3. **What is the distribution, relative abundance, behavior, and site use of wildlife determined to be of interest in Tiers 1 and 2, and to what extent do these factors expose these species to risk from the proposed wind power project?**

For those species of interest that are considered at risk to collisions or habitat impacts (e.g., displacement) it is of interest to know where they are likely to occur within a project site and in what abundance. The distribution of species at risk of collision can influence how a site is developed. This distribution should include the airspace for flying species. The abundance of a species and the distribution of its habitat can be used to determine the relative risk of impact to species using the sites and the absolute risk when compared to existing wind facilities where similar information exists and for use in modeling risk factors.

Distribution and relative abundance requires a complete coverage of the area of interest or a sample survey of the area using observational methods for the species of interest during the seasons of interest. As with presence/absence the methods used to determine distribution and abundance may vary with the species and its ecology. Distribution is determined by applying presence/absence or use surveys in a probabilistic manner over the entire area of interest. For example, presence of prairie grouse within the area of interest can be determined by visiting known male display areas (e.g., leks) during the breeding season to determine if any leks are active.

Because absolute abundance is difficult to determine for most species, surveys typically should estimate use as an index of abundance, for example, the relative abundance of breeding song birds can be considered the number of detections per period of survey per survey plot. Survey periods are typically 3-10 minutes for small bird surveys, depending on the site characteristics, and 20 minutes for raptors, or when all birds are the target of a survey. These statistics can be compared from plot to plot within the area of interest and from site to site where similar data exist. Relating use to site characteristics requires that samples of use also measure site characteristics thought to influence use (i.e., covariates such as vegetation and topography) in relation to the location of use. The statistical relationship of use to these covariates can be used to predict occurrence in unsurveyed areas during the survey period and for the same areas in the future.

Methods

Birds

Standardized methods and metrics

The standardized data collection method for estimating the distribution and relative abundance of diurnal birds is the bird use count. Depending on characteristics of a proposed project site and the bird species potentially affected by the project, additional pre-permitting study methods may be necessary.

For nocturnally active birds for birds that migrate at night, additional studies using different methods will be required if characteristics of the project site and surrounding areas potentially pose a high risk of collision to migrating songbirds and other species. This document discusses some of the primary tools available to study nocturnally active birds (for example radar, acoustic monitoring, visual monitoring) but does not provide standardized recommendations on duration or frequency of sampling or study design.

Early discussions with the permitting agency, USFWS, state wildlife agency, local agency, and interested conservation organizations is a crucial step in designing pre-permitting studies and deciding whether or not modifications to the standardized methods are warranted.

Bird Use Counts

The primary diurnal avian survey technique for pre-permitting studies at wind energy project areas is the bird use count (BUC), using avian point count or line transect sampling methods, and raptor nest searches. BUCs estimate the spatial and temporal use of the site by all birds, including large birds such as raptors, vultures, corvids, and waterfowl, as well as songbirds and other small species. BUC for passerines follows the methodology described by Reynolds et al. (1980) for point counts, only with a fixed area, or the line transect survey similar to Schaffer and Johnson (2008), where all birds seen within a fixed distance of a line are counted. The BUC for large birds, and when all birds are of interest, follows the same point count method described for passerines, although the radius of the survey is much larger, typically 0.8 Km. Point count plots or transects should be distributed throughout the area of interest using a probability sampling approach. Alternatively, the centers of the larger plots are located at vantage points throughout the potential area being considered with the objective of covering most of the area of interest. The BUC provides information regarding bird species and their use of the project site during the period of interest.

These survey techniques require experienced surveyors who are skilled at identifying the birds, accurately estimating vertical and horizontal distances and for raptors, accurately identifying nests for species that are likely to occur in the project area.

We recommend using the BUC protocol for large birds unless there is a specific interest in abundance and distribution of small birds. Nevertheless, all birds seen during these surveys, large or small, should be recorded during BUCs. Small Bird Counts (SBC) are discussed in more detail in a later section.

Sampling Duration/Frequency. The sampling duration and frequency must be determined on a project-by-project basis. The most important consideration for sampling frequency is the amount of variation expected among survey dates and locations and the species of interest. In areas where large birds (e.g., corvids, waterfowl, raptors) exhibit relatively high month to month variation in use but little distinct migration, surveys should be conducted at each plot for 20 minutes once a week for a year, or the period of occupancy if less than a full year. In areas where month to month variation is relatively small but there is a distinct migration season each plot should be surveyed once a week during the migration periods and twice per month during other periods of occupancy. The large BUCs should cover most daylight hours and weather conditions. However, each project needs to be considered individually. Please refer to the NWCC revised M&M (2009) document for detailed discussions regarding protocols.

Number/Distribution of Sample Points. A systematic sample of points is recommended to allow for statistical extrapolation of data to the area of interest. Alternatively, one can approximate a complete coverage of the areas proposed for a development. For large birds, BUC sample sites should be centered at vantage points that offer relatively unobstructed views of the surrounding terrain for a radius of approximately 800 meters. For the complete coverage of an area sites should be approximately 5,200 feet (1,600 meters) apart throughout the proposed facility, coinciding with proposed turbine sites, if they are known. In the case of small birds the plot radius or observational distance from the line transect should be approximately 50 m and a sample survey of the development site will be required (see discussion below for small bird counts). Refer to NWCC revised M&M (2009) document for more detailed discussion of sampling plans.

Variables. For each observation period record number and species of birds observed, distance from bird to observer, flight height above ground at the location of the bird, and environmental variables that are likely to affect detection of bird use (for example, wind speed). Refer to the NWCC revised M&M document for detailed discussion of data documentation.

Metrics. The metric for all bird use may be expressed a number of ways. Thus, recording the total number of birds seen during each survey period, , the total amount of time for each sample survey point and the area surveyed. An important parameter necessary for estimating exposure of birds to collisions is the total number of birds seen at various altitudes. Observations should be placed into a minimum of three altitude bands approximating the area below, within and above the rotor swept area. For modern turbines these bands are typically <35 m as being below the zone of risk, 35-130 m as being within, and >130 m as being above the rotor swept area. These data should allow for comparisons with most other studies of bird use following a similar protocol around the nation. For large birds we recommend that the amount of time each observed bird spends in the surveyed plot for the entire survey period be recorded. Thus, the amount of time a bird spends in the zone of risk can be quantified resulting in a better estimate of risk.

Other Diurnal Bird Survey Techniques

Raptor Nest Searches

An estimate of raptor use of the project site is obtained through the large BUCs, but if potential impacts to breeding raptors are a concern on a project, raptor nest searches are also necessary. These surveys provide information to estimate impacts to the local breeding population of raptors, for micro-siting decisions, and for developing an appropriately sized non-disturbance buffer around nests, as well as baseline data to use to estimate impacts and to determine compensatory mitigation requirements. Methods for these surveys are fairly standard, but draft protocols should be discussed with biologists from the lead agency, USFWS, state wildlife agency, and conservation organizations as applicable. At a minimum the protocols should contain the list of target raptor species for nest surveys, the appropriate search protocol for each site, including timing and number of surveys needed, search area, and search techniques.

Search Area. Conduct searches for raptor nests or raptor breeding territories on projects with potential for impacts to raptors in suitable habitat during the breeding season within at least one mile of wind resource area boundary.

Search Protocol. In open terrain conduct nest surveys from the air with ground follow up to determine species and nest status. Avoid approaching the nest too closely to minimize disturbance, particularly when surveying from helicopters. In forested habitat the surveys should be done from the ground. Using tape-recorded owl or diurnal raptor calls to promote nest defense behavior from the nesting raptor can be helpful in finding nests.

Small Bird Counts

At some locations there may be an interest it getting a better estimate of small bird distribution and use than is possible when using 800 meter radius plots. Diurnal small bird counts (SBCs) are point or line transect counts conducted at a greater density of smaller-radii point count circles or transects. We recommend SBCs using circular plots, although in open terrain SBCs can be conducted along walking transects (see the M&M Update document). This technique is most useful for pre- and post-construction studies assessing displacement effects and habitat losses to resident songbirds and other small birds (less than 10 inches [25 centimeters] in length) but, may be less useful for predicting fatality rates because studies have not shown a strong correlation between pre-project songbird use of the wind site and songbird fatalities. SBC point count sampling plots have a smaller radius, typically 50 meters, although plots up to 100 meters can be used in open areas with little vegetation. Savard and Hooper (1995) found that a 300-foot (100-meter) radius plots yielded nearly as many songbird detections as an unlimited radius for most species of birds.

SBC sampling points should be located systematically (with a random starting point) within the area proposed for turbine locations, if known. As a rule the points should be at least 820 feet (250 meters) apart to reduce the probability of double-counting individual birds (Ralph et al., 1995). If turbine locations are known, establish SBC sites every 820 feet (250 meters) in a row between turbines. Refer to the NWCC's revised M&M document (2009) for details in developing a sample design.

To determine which birds are breeding on the project site, SBCs should be conducted three times at approximately two-week intervals during the breeding season (April through July is the breeding season in much of the nation). Surveys should be conducted no earlier than a half-hour before and no later than four hours after sunrise. Time spent at each count station should be 10 minutes (Ralph et al., 1995). Refer to the NWCC's revised M&M document (2009) for more details.

If a precise estimate of density is required for a particular species (for example, when the goal is to determine densities of a special-status breeding bird species), the researcher will need more sophisticated sampling procedures including estimates of detection probability and should refer to the revised M&M document (2009) for sample design and protocol development.

Prairie Grouse Male Breeding Area (Lek) Counts

Male prairie grouse return to the same lekking grounds year after year to attract mates, and nesting and brood rearing habitat is generally located in the vicinity of these sites, although the distribution of females and young vary with vegetation and topography. It is generally agreed that breeding populations of prairie grouse should be assessed by either lek counts (a count of the maximum number of males attending a lek) or lek surveys (classification of known leks as active or inactive) during the breeding season (e.g., Connelly et al. 2000). Methods for lek counts vary slightly by species but in general require repeated visits to known sites and a systematic search of all suitable habitat for new leks, followed by repeated visits to active leks to estimate the number of grouse using the leks. Lek surveys require slightly less effort as the parameter of interest is whether the lek is active or not and a count of the number of grouse is not required. Both types of surveys may be done from the ground or a combination of ground and aerial surveys. Lekking areas should be visited for 15-30 minutes early in the morning, say 40 minutes before sunrise to 90 minutes after sunrise under good visibility and low wind conditions.

The extent of the impact of wind energy development on lekking activity and the associated impacts on breeding populations is poorly understood and is an area of much needed research. These effects should be addressed through Tier 5 studies on projects which proceed to construction.

Displacement Study Design

The study designs described below, before-after/control-impact (BACI), resource selection function (RSF) and impact gradient, are the optimal study designs to estimate indirect habitat (i.e., displacement) effects. Displacement refers to the indirect loss of habitat if birds avoid otherwise suitable habitat due to turbine operation and maintenance/visitor disturbance. Displacement can also result in fragmentation of habitat when birds are deterred from using normal routes to feeding or roosting grounds or large blocks of suitable habitat are broken into smaller blocks of less suitable habitat.

Displacement studies are considered Tier 5 studies and typically start during pre-construction (Tier 3). When the primary concern is small bird displacement point counts or line transect counts are typically used following the methods described above for SBCs. Point count or line transect counts for birds or their sign can also be used when displacement of larger birds, such as prairie grouse, is the primary concern. When the primary concern includes prairie grouse (prairie chickens, sharp-tailed grouse, and sage grouse) where anthropogenic activity negatively impacts use of suitable habitat for reproduction by the birds, avoidance, minimization and/or mitigation for lost habitat needs to be factored into the project early in its design. BACI studies involving radio telemetry are the best approach to quantify the impacts of the project on prairie grouse in different environments (tallgrass, mixed grass, sandsage, sagebrush, etc.). Generally these studies will measure impacts of the project development on nesting, nest success, and survival of prairie grouse. Because of the ecology of these species the sample size and study area requirements can be large and the studies are expensive. Examples of study designs and analyses are presented in Holloran et al. (2005), Pittman et al.

2005 and Robel et al.(2004).

BACI designs use data collected before and after a treatment (for example, construction of a wind project) at both the treatment sites and one or more reference sites. The BACI design requires data collection in both reference (control) and assessment (impact) areas using exactly the same protocol during both pre-impact and post-impact periods (Anderson et al., 1999) (NWCC's revised M&M, 2009). Perfect control sites, which exactly replicate the conditions at the proposed wind turbine site, usually do not exist in a field setting because of inherent natural variation. Thus, "controls" are reference sites that most closely match topographic, wind, and both on-site and adjacent habitat conditions at the proposed wind turbine site. Collecting data at both reference and assessment areas using the same protocol during both pre- and post-impact periods can help answer questions relating to construction and operation effects on bird abundance and distribution. Anderson et al. (1999) and the M&M update (2009) provide a thorough discussion of the design, implementation, and analysis of these kinds of field studies and should be consulted when designing the BACI study.

BACI designs with replicated reference sites provide a rigorous basis for statistical analysis and supportable scientific conclusions. Multiple references improve discrimination between project impacts and impacts resulting from natural temporal changes or other factors. This replication provides the basis for formal statistical testing on the impacts of the project and estimates of confidence intervals. A before-after study design with a single site, the site that will be developed but no reference site, only provides a comparison of data from before and after construction of the project. Such a weak study design limits the researcher's ability to make inferences and draw conclusions about the impact of the project because natural temporal changes are likely to confound detection of changes due to impacts.

A BACI study design is not always possible because locating appropriate reference areas that are not already planned for wind energy development may be difficult and wind project development schedules commonly preclude the collection of sufficient pre-treatment data for such a design. Furthermore, alterations in land use or disturbance over the course of a multi-year BACI study may complicate the analysis of study results.

An alternative approach that is effective in demonstrating displacement is the resource selection function (RSF) study design (See Anderson et al 1999 and the revised M&M document). Habitat selection is modeled as a function of characteristics measured on resource units and the use of those units by the animals of interest. See the answer to question #5 below for a more detailed explanation of RSF.

In certain situations, such as for a proposed wind development site that is relatively small and in a more or less homogeneous landscape, an impact gradient design may be a more appropriate means to assess impacts of wind turbines on resident populations (Strickland et al., 2002). Data are collected at various distances from turbines along transects. This approach not only provides information on whether there is an effect, it may also allow quantification of the gradient of the effect and the distance at which the effect no longer exists. The assumption is that the data collected at distances beyond the influence of turbines are the reference data (Erickson et al., 2007). For example, a project located in homogeneous grasslands might use impact gradient analysis to assess project impacts to resident songbirds. An impact gradient analysis could for example involve measuring the number of breeding grassland birds counted at BUC plots as a function of distance from the wind turbines.

Mist-Netting for Birds

Normally, mist-netting is not recommended as a technique for estimating relative bird abundance. Mist-netting cannot generally be used to develop indices of relative bird abundance, nor does it provide an estimate of collision risk. Operating mist-nets is expensive and requires considerable experience, as well as state and federal permits.

Occasionally mist-netting can be used to augment observational bird data, and help confirm the presence of rare species at documented fallout or migrant stopover sites. If mist-netting is to be used, follow procedures for operating nets and collecting data in accordance with Ralph et al. (1993).

Nocturnal Bird Survey Methods

Most songbirds, waterfowl, shorebirds, herons, and egrets migrate at night (Kerlinger and Moore, 1989), and radar studies yield some insight into general patterns of night flying behavior. Nocturnal migrants generally take off after sunset, ascend to their cruising altitude between 300 and 2,000 feet (90 to 610 meters), and return to land before sunrise (Kerlinger, 1995). For most of their flight, songbirds and other nocturnal migrants are above the reach of wind turbines, but they pass through the altitudinal range of wind turbines during ascents and descents and may also fly closer to the ground during inclement weather (Able, 1970; Richardson, 2000). In general, studies show that the paths of high elevation nocturnal migrants are little affected by topography or habitat beneath, but some studies suggest that landforms can have a significant guiding effect for birds flying below 300 feet (100 meters) (e.g. Williams et al., 2001). Radar studies reveal that major nocturnal migrations are triggered by weather (Gauthreaux and Belser, 2003) and often occur on nights with light tail winds. Low cloud cover or head winds can reduce the above-ground-level altitudes of migrants, bringing more birds within range of turbine blades (Richardson, 2000). Under certain conditions, such as low-lying fog, cloud cover might increase the flying height of birds that might find clear skies above.

Once nocturnal migrants descend from their night's flight and select a site for cover, foraging, and resting, local landforms and habitat conditions may play a role in determining where they alight (Mabey, 2004). Biologists knowledgeable about nocturnal bird migration and familiar with patterns of migratory stopovers in the region should assess the potential risks to nocturnal migrants at a proposed wind energy project site. In general, pre-permitting nocturnal studies are not recommended unless the site has features that might strongly concentrate nocturnal birds, such as along coastlines that are known to be migratory songbird corridors. If warranted, employ marine radar and other nocturnal study methods following Kunz et al. (2007) to determine relative abundance, flight direction and flight altitude of nocturnal flying animals passing through the site to assess risk to migrating birds. If project areas are within the range of nocturnal, special-status bird species (for example, marbled murrelet or northern spotted owl), surveyors should use species-specific protocols recommended by state wildlife agencies or USFWS to assess the species' potential presence in the project area.

The estimation of distribution and relative abundance of nocturnal flying birds are even more difficult as tools for detection are mostly indirect. The tools for the study of nocturnally flying birds are summarized in an appendix to the updated M&M document (and see Kunz et al, 2007).

Generally, for Tier 3 studies of relative abundance of nocturnally active birds can be determined by using marine radar and/or NEXRAD. Unfortunately neither form of radar allows separation of detected targets into birds and bats. Some effort has been made to use night vision equipment to separate the two groups of flying organisms, but these methods have not been evaluated for their relative probability of detection. Auditory surveys have also been used for birds with some success (Kunz et al 2007), although with less success for birds than for bats. Detection probabilities have also not been studied, the range of detection for the equipment is limited, and the data confirm presence but not absence because not all birds vocalize within the range of the equipment and not all species vocalize at the same rate.

In contrast to the diurnal avian survey techniques previously described, considerable variation and uncertainty exist on the optimal protocols for using acoustic monitoring devices, radar, and other techniques to evaluate species composition, relative abundance, flight height, and trajectory of nocturnal migrating birds. The use of radar for determining passage rates, flight heights and flight directions of nocturnal migrating animals has yet to be shown as a good indicator of risk of collision, and additional studies are needed before making recommendations on the number of nights per season or the number of hours per night that are appropriate for radar studies of nocturnal bird migration (Mabee et al., 2006).

We do not make specific recommendations on duration or frequency of sampling or study design. The NWCC has developed guidelines that describe the metrics and methods used to study nocturnal birds and bats (Kunz et al. 2007). Consult these guidelines, which are available at the NWCC Web site (hyper link) and as an appendix to the updated M&M, before developing pre-permitting studies of nocturnal migration. Each of the methods described here has strengths and weaknesses for answering questions about collision risk. No one method by itself can adequately assess the spatial and temporal variation in nocturnal bird populations or the potential collision risk.

Nocturnal bird study methods and collision risk are areas of active research and worthy of investigation by collaborative public-private research partnerships.

Bat Survey Methods

Acoustic monitoring is perhaps the most practical method for monitoring bats at proposed wind facilities (Kunz et al. 2007). Acoustic monitoring provides information about bat presence and activity, as well as seasonal changes in species composition and use, but does not measure the number of individual bats or population density. Passive acoustic surveys can provide baseline patterns of seasonal bat activity at proposed wind energy sites, but researchers should be aware that with the current state of knowledge about bat-wind turbine interactions, a fundamental gap exists regarding links between pre-permitting assessments and operations fatalities. The ability to predict fatalities, and thus risk, from acoustic data has not yet been established, and acoustic data gathered in Tier 3 should be linked with Tier 4 post-construction fatality data from multiple facilities.

Acoustic monitoring should be used at sites to estimate seasonal use at proposed wind facility sites where potential bat fatalities are of concern. Notwithstanding, discussions with experts, state wildlife trustee agencies, and USFWS will be needed to assist in the determination as to the credibility and applicability of any existing data and to assess whether acoustic monitoring is warranted at a proposed wind energy site. The NWCC's revised M&M (2009) document and Kunz et al. (2007) provide more detailed discussion of sampling techniques.

Duration of Acoustic Monitoring. Acoustic monitoring for bats generally should be performed at proposed wind energy sites unless defensible, site-specific data are available indicating that the project is unlikely to pose a risk to bats. Monitoring for a full year is recommended in warmer climates because little is known about the timing of bat migratory activity in many parts of the country and some bat species overwinter in some southern states and can be active throughout the year. Year-round surveys are particularly important at proposed project sites if, in the opinion of bat experts involved in scoping the pre-permitting studies, the sites are likely to support resident bat populations and include habitat features conducive to general bat activity (for example, nearby roosts, water bodies). If year-round surveys are not feasible or necessary, acoustic monitoring should include at least spring and fall migration, the periods that pose the greatest risk to bats. Data on environmental variables such as temperature, precipitation, and wind speed should be collected concurrently with acoustic monitoring so these weather data can be correlated with bat activity levels.

Number and Distribution of Monitoring Stations. The number and distribution of sampling stations has not been well established, but multiple sampling stations will be required to account for spatial variability. If variation among sampling stations is low then fewer stations will be needed, whereas the opposite is true for sites with high variability among sampling stations. At sites where there is high variability in bat calls, or those sites where no data occur to evaluate site-to-site variability, we recommend that all existing met towers be equipped with detectors. Additional sampling may be needed to supplement detectors placed on met towers to adequately sample some sites.

Two acoustic detector systems should be placed at both high and low positions on each meteorological tower in the proposed project area. The “ground-level” detectors should be approximately 5 feet (1.5 meters) above the ground to avoid interference from vegetation, and the elevated detectors should be located as high as possible without interfering with weather monitoring equipment.

Data Collection and Analysis. Acoustic data should be gathered at least ½ hour before sunset to ½ hour after sunrise each night of monitoring, and data should be collected continuously through the duration of the study. Call analysis should be performed by individuals trained in these analyses using appropriate software for specific detector systems.

Metrics. A “bat pass” is defined as a sequence of two or more echolocation calls, with each sequence, or pass, separated by one second or more (Fenton 1970, Thomas and West 1989, Hayes 1997). Bat passes are used as an index of activity, but it is important to understand that they do not indicate the number of individuals. The total bat passes and mean passes per detector night and per detector hour (excluding nights with measurable precipitation) are metrics used to express activity.

Other Bat Survey Techniques

Other research tools are available to complement the information from acoustic surveys. These methods are not necessarily needed for every project, but may be required to answer particular questions about size, species composition, behavior, and activity patterns of roosts or to further investigate habitat features that might attract bats. Kunz et al. (2007) provides a comprehensive description of bat survey techniques in relation to wind facilities. Methods for assessing colony size, demographics, and population status of bats can be found in O'Shea and Bogan (2003). Kunz et al. (1996) provide detailed guidelines on capture techniques for bats, including mist-nets and harp traps.

Biologists with training in bat identification, equipment use, and data analysis and interpretation should design and conduct all studies discussed below. Mist-netting and other activities that involve capturing and handling bats may require permits from state and/or federal agencies.

Mist-Netting. We do not recommend mist netting as a standard method for assessing risk of wind development to bats for the following reasons: 1) not all proposed or operational wind energy facilities offer conditions conductive to capturing bats and often the number of suitable sampling points is minimal or not closely associated with the project location; 2) capture efforts often occur at water sources offsite or at nearby roosts and the results may not reflect species presence or use on the site where turbines are to be built; and 3) mist-netting isn't feasible at the heights of the rotor-swept zone and captures below that zone may not adequately reflect risk of fatality.

If mist-netting is to be used it is best used in combination with acoustic monitoring to inventory the species of bats present at a site (Kuenzi and Morrison 1998, O'Farrell et al., 1999). If mist-netting is to be used to augment acoustic monitoring data at a project site, trapping efforts should concentrate on potential commuting, foraging, drinking, and roosting sites.

Exit Counts / Roost Searches

Pre-permitting survey efforts should include an assessment to determine whether known or likely bat roosts in mines, caves, bridges, buildings, or other potential roost sites could occur near proposed wind turbine sites. If active roosts are detected during this assessment, exit counts and roost searches should be conducted to assess the size, species composition, and activity patterns for any bat-occupied features near project areas. Rainey (1995) provides a guide to options for exit counts.

Roost searches should be performed cautiously because roosting bats are sensitive to human disturbance (Kunz et al., 1996). Known maternity roosts should not be entered or otherwise disturbed. Searches of abandoned mines or caves can be dangerous and should only be conducted by experienced researchers. For mine survey protocol and guidelines for protection of bat roosts, see the appendices in Pierson et al. (1999). Multiple surveys will be required to determine presence of bats in caves and mines (up to 12 or more surveys in some regions; see Sherwin [2003]).

Other Wildlife

The distribution and relative abundance of diurnally active animals can generally be determined with systematic observational surveys of the area of interest using point count or line-transect surveys (Anderson et al 1999; Updated M&M), looking for animals, their sign, or both. Protocols and survey methods for reptiles and amphibians are well established (e.g., Corn and Bury 1990, Hobbs et al. 1994, Olson et al. 1997, Ryan et al. 2002, Bailey et al. 2004, Graeter et al. 2008), and specific protocols for specific sites should be determined and agreed upon with state and federal agencies. If absolute abundance is desired then line-transect methods using distance or mark-recapture methods described in (Morrison et al 2006) will be necessary. Sign is typically used as an indication of use rather than abundance. Sign may be used as an indicator of relative abundance for some species, one must be aware of the potential for differential use of different types of habitat. For example, mammals often leave more feces near feeding, bedding or hiding cover and less during movements. Alternatively, prairie dog relative abundance is frequently based on the number of active burrows in a given unit of study. An active burrow is typically based on the presence of a prairie dog or it sign at the burrow entrance.

Estimation of distribution and relative abundance for nocturnally active species is more difficult as direct observation is difficult. For mammals, surveys of indirect measures of animal abundance, such as track counts, is often required. As with diurnally active species, surveys for sign must recognize the potential for differential use of different types of habitat.

Risk Assessment: In answering the above questions developers should collect sufficient data to enable analysis that answers the following questions:

4. **What are the potential risks of impacts of the proposed wind energy project to individuals and local populations and their habitat. When appropriate (e.g., rare and/or endangered species) assessment of risk may also include possible impacts to entire species and their habitats**.

Risk can be defined as the likelihood that an adverse effect may occur as a result of exposure to one or more sources of impact, and the consequences of that effect. For example, the risk that a fatality of a particular species will occur can be determined by dividing the number of fatalities (impact) by the number of birds in the zone of risk (exposure). Risk to populations is more complicated and could be considered the likelihood of reduction in the growth rate of the population, either local, metapopulations or entire species.

The potential impacts include individual collision fatalities, habitat loss, habitat fragmentation, and reduction in reproduction and survival. The potential for avoidance, minimization, or mitigation of the potential risks depends on the species.

Methods used for estimation of risk vary with the species of interest. Exposure estimation was covered earlier (e.g., bird use counts). The empirical estimation of fatalities will be covered in the discussion of Tier 4. Estimating potential fatalities in Tier 3 may be accomplished by comparing species distribution and abundance at the proposed site with the distribution, abundance, and fatalities at existing facilities with similar characteristics (e.g., similar technology and landscape).

Estimating potential bird fatalities can also be accomplished through the use of an individual-based mathematical model for the estimation of probability of bird/turbine collisions. Most models incorporate Tucker's (1996) approach for estimating a bird's probability of collision with the rotor blades. Newer models improve on Tucker's model by including an opportunity to collide with the nacelle and support structure and incorporate bird avoidance behavior. The models address the physical and dynamic characteristics of the proposed turbines, as well as the spatial arrangement of the individual turbines within the wind facility. The models should also include wind characteristics at the site based on historical records. Furthermore, bird characteristics including size, flight speed, and avoidance behaviors should be incorporated. Collision probabilities are assessed by simulating flight paths of individual birds through the wind facility and calculating the proportion of all such paths that resulted in collision. Simulations should be conducted for a variety of conditions including bird taxonomic group, season, and period of the day (diurnal and nocturnal).

The estimation of displacement impacts requires empirical data on animal behavior in response to wind facilities and would be considered a Tier 5 study. Displacement can be inferred from abundance before and after a facility is constructed. The magnitude of displacement can also be empirically estimated by estimating use as a function of distance to turbines and other facilities. The most direct estimation of displacement requires radio telemetry studies.

Distribution, relative abundance, and behavior of birds and bats using a site interact to influence risk to individual species from a wind facility. If a species has high or low abundance but their behavior does not place individuals within the zone of risk, then they are at low risk of collision with a turbine. If a species has high abundance (e.g., a nocturnal migrating passerine) but its behavior (e.g., flight characteristics) keeps it out of the zone of risk during migration then individuals of the species are at low risk of collision with a turbine blade during migration. If a species has low or high abundance and it frequently occupies the zone of risk, but it effectively avoids collisions (e.g. ravens) then individuals are at low risk of collision with a turbine.

If the behavior of a species frequently places them in the zone of risk and they do not actively avoid turbine blade strikes then individuals of the species are at greater risk of collisions with turbines, regardless of abundance. For a given species (e.g., red-tailed hawk) increased abundance increases the likelihood that individuals will be killed by turbine strikes, although the risk to individuals is relatively the same. The risk to a population increases as the proportion of individuals in the population at risk to collision increases.

If a species occupies the area where a wind facility is proposed, and its behavior causes individuals to avoid areas in proximity to turbines, roads and other components of the facility then there is a high risk that otherwise suitable habitat will be lost to the individuals. The amount of habitat that is lost to displacement will be a function of the sensitivity of individuals to turbines, roads, and other components of the facility, and to the activity levels associated with the project's operations. The significance of the loss of this habitat depends on the amount of habitat available to the affected population. If the loss of habitat results in habitat fragmentation then the risk to the demographic and genetic viability of the isolated animals is increased. Little is known about the exposure risk of bats at turbines and, unlike birds, the issue is complicated by the fact that bats may be attracted to turbines. Research is required to address this question for bats.

5. **If significant impacts are predicted with respect to wildlife and their habitats, what avoidance, minimization, or mitigation strategies are identifiable?**

In cases where the potential for significant adverse impacts is predicted with respect to a proposed project, and the project's developer wishes to proceed with its construction, then the information collected during Tier 3 studies provides an appropriate basis for the identification of measures for avoiding, minimizing, or providing compensatory mitigation for those impacts. Information on wildlife use of the proposed area is most useful when designing a project to avoid or minimize impacts. For example, in baseline studies of the proposed Wyoming Wind Energy Project, field observations demonstrated that most raptor use of the site was within 50 meters (164 feet) of the edge of the mesa where the project was to be sited (Johnson et al. 2000). Based on this information the developer chose to modify the site development plan to reduce the risk of raptor fatalities. Turbines were sited so that turbines would not be constructed within this zone of high raptor use. Similar avoidance buffers can be placed around other wildlife concentration areas such as breeding display areas (e.g., sage grouse leks), raptor nests, bat hibernacula, and other areas of concentrated use by species of concern. Avoidance buffers require detailed information on animal behavior in relation to wind energy facilities and their components, and this is an area of much needed research (NRC 2007). Other options include changing operational criteria to reduce the risk of impacts. For example, Arnett et al. (2009) and Baerwald and Barclay (2009) evaluated the potential for using varying cut-in speeds for turbines during periods of high risk to reduce bat fatalities. These studies demonstrated substantial reduction in bat fatalities by increasing turbine cut-in speeds to between 5 and 6.5 m/s (between 11.2 and 14.5 mph). Evaluation of these strategies would occur as a Tier 4 or Tier 5 study.

When significant adverse ecological impacts cannot be fully avoided or adequately minimized, some impacts may need to be mitigated. For example, it may be possible to mitigate habitat loss or degradation for a species of interest by replacing or restoring nearby habitat comparable to that potentially influenced by the wind project. An example of such an initiative is the 2008 Meridian Way Conservation Project, in central Kansas, under which Horizon Wind, The Nature Conservancy, the Ranchland Trust of Kansas, and state and federal wildlife agencies are cooperating voluntarily to restore and protect grassland landscape to offset prairie ecosystem detriments resulting from Horizon's nearby wind farm. Another example is an agreement through which Oklahoma Gas & Electric will provide funding to the Oklahoma Department of Wildlife Conservation to voluntarily offset impacts to lesser prairie chicken habitat in northwest Oklahoma. The ODWC intends to leverage OG&E's investment with matching funds from multiple federal, foundation and NGO partners, creating the Southern Plains' largest voluntary conservation project for lesser prairie chicken. In both cases, the associated wind energy projects were deemed to have significant, but mitigatable impacts, which are being addressed, in large part, by habitat improvements and long-term protection which are financially supported by the wind energy developers.

Impact avoidance, minimization and mitigation is an area of much needed research (NRC 2007). The technical feasibility and cost of impact avoidance, minimization and mitigation are important factors for companies to consider when evaluating a potential site for development.

6. **Are there studies that should be initiated at this stage that would be continued in either Tier 4 or Tier 5?**

Not all Tier 3 studies will continue into Tiers 4 and/or 5. For example, surveys conducted in Tier 3 for a threatened, endangered, or species of concern may indicate the species is not present at the proposed site, or siting decisions could be made in Tier 3 that remove identified concerns; thus, continued efforts in later tiers are not necessary. For other species or issues of concerns, Tier 3 studies may be continued in later tiers.

As a part of problem formulation in Tier 3, the need for post-construction impact estimation and/or mitigation should be evaluated. If post-construction impact evaluation is necessary then the design for these studies should be determined based on the specific impact questions being addressed. For example, pre-construction activity data for bats may be used to predict post construction bat fatalities and the evaluation of these predictions will require estimates of the correlation between these two parameters. In this example, Tier 3 studies provide an estimate of bat use and a prediction of bat fatalities, while Tier 4 studies provide the estimate of bat fatalities and an evaluation of the correlation between pre-construction use and post-construction fatalities.

Other questions may require an evaluation of the impact of the wind facility on demographic parameters of local populations, habitat use, or some other parameter(s), requiring data on these parameters prior to and after construction of a wind facility. For example, pre-construction data on spatial distribution of prairie chickens (Tier 3) may suggest that some leks are likely to be abandoned as the result of the construction of a facility. This impact prediction can be confirmed by completing studies of the spatial distribution of prairie chickens after the project is completed (Tier 5) and comparing those results to pre-construction data. Likewise, predicted impacts on prairie grouse population demographics (nesting, nest success, survival, and so on) can be assessed by collecting such data prior to (Tier 3) and after construction of wind facilities (Tier 5). Additionally, project features may be altered to avoid or minimize predicted impacts. Using the prairie chicken example above, measures may be implemented to reduce the impact on leks as the project is constructed. These risk reduction measures may be evaluated using pre- (Tier 3) and post- (Tier 5) construction estimates use of leks by prairie chickens to determine if the risk reduction measures were successful. Finally, the developer may, based on Tier 3 data, determine that unacceptable impacts will be mitigated. Again, using the prairie chicken example, pre-construction information on spatial distribution and demography pre-construction can be compared to post-construction estimates of the same parameters to determine the effectiveness of mitigation measures.

Confirming the relationship between pre- and post-construction parameters so that these relationships can be generalized with confidence to other proposed facilities will require that studies at multiple facilities be combined to determine if there are consistent and predictable patterns. For example, using Tier 3 estimates of use and Tier 4 estimates of fatalities one can evaluate whether the pre-construction prediction of fatalities were accurate for a particular project. Because only one facility is being studied, and this facility is not a random sample of all potential facilities, the use of this relationship in predicting fatalities at other proposed facilities is strictly subjective. Determining the relationship of activity data and fatalities for use in making statistical predictions of potential fatalities at other facilities will require the coalescence of data from multiple sites in a meta-analysis. Notwithstanding the need for methods to accurately predict fatalities at proposed facilities, the studies necessary to confirm these relationships are beyond the scope of an individual project and should be a collaborative effort among several projects and other stakeholders. These replicated studies are critical for examining methods and the predictability of fatalities for future risk assessments and will benefit wildlife conservation and the wind energy industry.

The BACI design is considered an optimal design for estimating impact and mitigation response (see Anderson et al. 1999 and the revised M&M document). The BACI requires that data be collected pre- (i.e., Tier 3) and post-construction (Tiers 4 and/or 5). Where no preconstruction data exists on treatment and control areas and the impact area is homogenous with respect to vegetation, topography and species of use, an alternate study design may be used such as the impact gradient design (See Anderson et al 1999 and the revised M&M document). The resource selection function (RSF) approach is an alternative method of study that effectively demonstrates impacts such as displacement (see Anderson et al 1999 and the revised M&M document). Habitat selection is modeled as a function of characteristics measured on resource units and the use of those units by the animals of interest. The RSF value of the unit is proportional to the probability of the unit being used. The RSF allows the estimation of the probability of use as a function of the distance to various environmental features, including wind facilities and thus provides a direct quantification of the magnitude of the displacement effect. RSF could be improved with preconstruction and reference area data, nevertheless, it is a relatively powerful approach to documenting displacement and/or a response to mitigation measures designed to reduce displacement even without these additional data.

D. Site Construction: Site Development and Construction Best Management Practices

During site planning and development, significant attention should be given to reducing risk of adverse impacts to wildlife from turbines and associated infrastructure through careful site selection and facility design. The following best management practices (BMPs) can assist a developer in the planning process to reduce potential wildlife impacts. Use of these BMPs should ensure that the potential adverse impacts to most wildlife and habitat present at many wind development sites would be reduced, although additional compensatory mitigation may be required at a project level to address significant site-specific concerns and pre-construction study results.

These BMPs will evolve over time as additional experience, learning, monitoring and research becomes available on how to best minimize wildlife and habitat impacts from wind facilities. USFWS will work with the industry, stakeholders and the states to evaluate, revise and update these BMPs on a continual basis, and the USFWS will maintain a readily available publication of recommended, generally accepted best practices.

1. Minimize, to the extent practicable, the area disturbed by pre-construction site monitoring and testing activities and installations.

2. Avoid locating turbines in areas identified as having potentially high risk to birds and bats

3. Avoid using or degrading high value or large intact habitat areas, as identified in state wildlife action plans.

4. Use maps that show the location of sensitive resources and the results of Tier 2 and/or 3 studies to establish the layout of roads, fences, and other infrastructure.

5. Avoid using invasive species when seeding or planting during restoration.

6. To reduce avian collisions, place low and medium voltage connecting power lines associated with the wind energy development underground to the extent possible, unless burial of the lines is prohibitively expensive (i.e., where shallow bedrock exists) or where greater impacts to biological resources would result.

    a. Overhead lines may be acceptable if sited away from high bird crossing locations, such as between roosting and feeding areas or between lakes, rivers and nesting areas.
    b. Overhead lines may be used when they parallel tree lines, employ bird flight diverters, or are otherwise screened so that collision risk is reduced.
    c. Above-ground low and medium voltage lines, transformers and conductors should comply with the 2006 or most recent Avian Power Line Interaction Committee (APLIC) "Suggested Practices for Avian Protection on Power Lines."

7. Communication towers and permanent meteorological towers should not be guyed at turbine sites. If guy wires are necessary, bird flight diverters or high visibility marking devices should be used.

8. Use construction and management practices to minimize activities that may attract prey and predators to the wind turbine site.

9. FAA visibility lighting of wind turbines should employ only red, or dual red and white strobe, strobe-like, or flashing lights, not steady burning lights.

10. Keep lighting at both operation and maintenance facilities and substations located within ½ mile of the turbines to the minimum required.

    a. Use lights with motion or heat sensors and switches to keep lights off when not required.
    b. Lights should be hooded downward and directed to minimize horizontal and skyward illumination.
    c. Minimize use of high intensity lighting, steady-burning, or bright lights such as sodium vapor, quartz, halogen, or other bright spotlights.

11. Establish non-disturbance buffer zones to protect raptor nests, bat roosts, areas of high bird or bat use, or specials-status species habitat identified in pre-construction

studies. Determine the extent of the buffer zone in consultation with USFWS and state, local and tribal wildlife biologists, and land management agencies (e.g., BLM).

12. Locate turbines to avoid separating birds and bats from their daily roosting, feeding, or nesting sites if documented that the turbines' presence poses a risk to species.

13. Use tubular towers (as opposed to lattice towers) or best available technology to reduce ability of birds to perch and to reduce risk of collision.

14. Minimize the number and length of access roads, use existing roads when feasible.

E. Site Operation - Conduct Tier 4 and Tier 5 Studies, as Appropriate (Post-construction fatality studies and other post-construction studies)

1. Tier 4 Methods for Post-Construction Fatality Studies

These methods focus specifically on post-construction fatality monitoring and involve searching for bird and bat carcasses beneath turbines to determine overall fatality rates, and to answer other questions regarding species composition of fatalities, relationships with site characteristics, comparison of fatalities among facilities, comparison of actual and predicted fatality rates estimated in previous tiers, and determining if fatality rates warrant corrective management or mitigation measures. The level of effort and seasonality of studies may vary depending on several factors, including site sensitivity and risk level, amount and quality of existing data from nearby sites, seasons of occupancy, and affected species of interest. The questions and methods described here generally assume at least two years of post construction data. We recommend two years of fatality monitoring, which is consistent with most state guidelines and provides some indication of variation among years. Two years of monitoring can be adjusted if appropriate, following discussions with the USFWS, state wildlife agency, permitting agency and other stakeholders. For example, if a site had been determined to be low-risk, and first-year Tier 4 studies indicate that impacts are low, suspension of monitoring may be appropriate.

Methods for Estimating Fatality Rates

Fatality monitoring results should be of sufficient statistical validity to answer Tier 4 questions, to allow comparisons with pre-construction impact predictions and comparisons with other sites, and to provide a basis for determining if corrective management or mitigation measures at the site are appropriate. Protocols should be standardized to the greatest extent possible, especially for common objectives and species of interest, and they should included methods for adequately accounting for sampling biases (search efficiency and scavenger removal). However, some situations warrant exceptions to standardized protocol, and the responsibility of demonstrating that an exception is appropriate and applicable should be on the stakeholder attempting to justify increasing or decreasing the duration or intensity of operations monitoring.

We recommend that each search plot should be divided into oblong subplots or belt transects and that each subplot be searched. The objective is to find as many carcasses as possible so the width of the belt will vary depending on the ground cover and its influence on carcass visibility. In most situations a search radius of 3 meters should be adequate. Notwithstanding, search radii may vary from 1.5-5 meters depending on ground cover.

More detailed descriptions and methods of fatality search protocols and can be found in the California (California Energy Commission 2007) and Pennsylvania (PGC 2007) state guidelines and the following publications: Kunz et al. (2007), Smallwood (2007), and the revised methods and metrics document (citation coming soon).

Duration and Frequency of Monitoring. Duration and frequency of fatality searches within a year will vary depending on the questions to be answered, the species of interest, season of searching, and estimated carcass removal rates. As a general rule the search interval should be no greater than twice the mean removal rate. Consequently, a search interval of 7 days is typically adequate to answer Tier 4 questions. Notwithstanding, larger or smaller search intervals may be justified. If the primary objective is fatalities of large raptors and carcass removal is low, then a longer interval between searches (e.g., 14-28 days) and larger subplots (3-5 meters radius) are sufficient. However, if the focus is fatalities of bats and small birds and carcass removal is high, then a search interval of < 7 days will be necessary. For example, if the mean removal rate established by carcass removal trials is 2 days, then the search interval should be no more than 4 days and subplots should be smaller (e.g., 1.5-3 m).

There are situations in which studies of higher intensity (e.g., daily searches at individual turbines within the sample) may be appropriate in the first year of post-construction monitoring. These would be considered Tier 5 studies because of the greater complexity and level of effort. These Tier 5 studies could include evaluation of specific measures that have been implemented to mitigate potential impacts to threatened or endangered species, or species of particular concern identified during pre-construction studies.

Number of Turbines to Monitor. Data from existing facilities in similar conditions in the same region should be used, if available, to determine variability among turbines to determine needed sample size (see M&M). If data are not available, then a sufficient number of turbines should be selected via a systematic sample with a random start point. Sampling plans can be varied (e.g., rotating panels [M&M update]) to increase efficiency as long as a probability sampling approach is used. If the project contains less than 10 turbines, all turbines in the project area should be searched unless otherwise agreed to by the regulating agencies. When selecting turbines, it is recommended that a systematic sample with a random start be used when selecting search plots to ensure interspersion among turbines. Also stratification among different habitat types is recommended to account for differences in fatality rates among different habitats (e.g., grass versus cropland or forest); a sufficient number of turbines should be sampled in each strata.

Delineation of Carcass Search Plots, Transects, and Habitat Mapping. Evidence suggests that >80% of bat fatalities fall within ½ the maximum distance of turbine height to ground (Erickson 2003 a, b), and a minimum plot radius of 60 m from the turbine should be established at sample turbines. Plots will need to be larger for birds, with a radius of the maximum distance of turbine height to ground. Decisions regarding search plot size should be determined in discussions with the USFWS, state wildlife agency, permitting agency and other stakeholders Searchable area within the theoretical maximum plot size varies and heavily vegetated areas (e.g., eastern mountains) often do not allow surveys to consistently extend to the maximum plot radius; thus, the searchable area of each turbine must be delineated and mapped to adjust fatality estimates based on the actual area searched. If needed, habitat visibility classes should be established in each plot to account for differential detectability. It may be necessary to develop visibility classes for different landscapes (e.g., rocks, vegetation) within each search plot. For example, PGC (2007) identified 4 classes based on the percentage bare ground.

The use of visibility classes will require that detection and removal biases be estimated for each class. Fatalities estimates should be made for each class and summed for the total area sampled. Global positioning systems (GPS) are useful for accurately mapping the actual total area searched and area searched in each habitat visibility class, which can be used to adjust fatality estimates. The width of the belt or subplot searched may vary depending on the habitat and species of interest; the key is to determine actual searched area and area searched in each visibility class regardless of transect width. An adjustment may also be needed to take into account the density of fatalities as a function of the radius of the search plot.

General Search Protocol Guidance. Trained searchers should look for bird and bat carcasses along transects or subplots within each plot and record and collect all carcasses located in the searchable areas. A complete search of the area should be accomplished and subplot size (e.g., transect width) should be adjusted to compensate for detectability differences in the search area. Subplots should be smaller when vegetation makes it difficult to detect carcasses; subplots can be wider in open terrain. Subplot width can vary depending on the size of the species being looked for. For example, small species such as bats may require smaller subplots than larger species such as raptors. Data to be recorded includes date, start time, end time, observer, which turbine area was searched and weather data for each search. When a dead bat or bird is found, the searcher should place a flag near the carcass and continue the search. After searching the entire plot, the searcher returns to each carcass and records information on a fatality data sheet, including date, species, sex and age (when possible), observer name, turbine number, distance from turbine, azimuth from turbine, habitat surrounding carcass, condition of carcass (entire, partial, scavenged), and estimated time of death (e.g., ≤1 day, 2 days). Rubber gloves or an inverted plastic bag should be used to handle all carcasses to reduce possible human scent bias for carcasses later used in scavenger removal trials. Carcasses should be placed in a plastic bag and labeled. Fresh carcasses, those determined to have been killed the night immediately before a search, should be redistributed at random points on the same day for scavenging trials.

Field Bias and Error Assessment. It has long been recognized that during searches conducted at wind turbines, actual fatality is incompletely observed and that carcass counts must be adjusted by some factor that accounts for imperfect detectability. Important sources of bias and error include: 1) fatalities that occur on a highly periodic basis; 2) carcass removal by scavengers, 3) detectability by different searcher, 4) failure to account for the influence of site (e.g. vegetation) conditions in relation to carcass removal and searcher efficiency, and 5) fatalities or injured bats that may land or move outside search plots.

To address biases sources 2-4 above, all fatality studies must conduct carcass removal and searcher efficiency trials using accepted methods discussed in the revised methods and metrics document (citation coming soon). Bias trials should be conducted throughout the entire study period and searchers should be unaware of which turbines are to be used or the number of carcasses placed beneath those turbines during trials. Prior to a study's inception, a list of random turbine numbers and random azimuths and distances (m) from turbines should be generated for placement of each bat or bird used in bias trials. Data recorded for each trial carcass prior to placement should include date of placement, species, turbine number, distance and direction from turbine, and visibility class surrounding the carcass. Trial carcasses should be distributed as equally as possible among the different visibility classes throughout the study period and study area. Studies should attempt to avoid "over-seeding" any one turbine with carcasses by placing no more than one or two carcasses at any one time at a given turbine. Before placement, each carcass must be uniquely marked in a manner that does not cause additional attraction and have its location recorded. There is no agreed upon sample size for bias trials, though some state guidelines recommend 200 carcasses, and we recommend a minimum of 50 be used seasonally (PGC 2007). Most researchers agree that sample size of carcasses used for bias trials should be maximized to the greatest extent practical.

Some fatalities may occur on a highly periodic basis creating a potential sampling error, error number 1 above. We recommend that sampling be scheduled so that some turbines are searched most days so that episodic events are more likely detected, regardless of the search interval.

Carcasses or injured individuals may land or move outside the search plots, error number 5 above. This potential sampling error could be estimated by sampling outside the standard search plot for a subsample of turbines, but it is unlikely that this error will ever be accurately estimated. Additionally, based on the distribution of carcasses in plots this error is considered to be small and studies that expand the standard search plot could be used to evaluate the magnitude of the error.

Estimators of Fatality. If there were a direct relationship between the number of carcasses we observe and the number that were killed, there would be no need to develop a complex estimator that adjusts observed counts for detectability, and observed counts could be used as a simple index of fatality. But the relationship is not direct and raw carcass counts recorded using different search intervals and under different carcass removal rates and searcher efficiency rates are not directly comparable. Only the most contemporary equations for estimating fatality should be used, as some original versions are now known to be extremely biased under many commonly encountered field conditions; the revised methods and metrics document should be used as a current source for estimators of fatality (citation coming soon).

Objectives and Metrics used for Fatality-Related Questions

1. What is the bird and bat fatality rate for the project?

The primary objective of fatality searches is to determine the overall estimated fatality rate for birds and bats for the project. These rates serve as the fundamental basis for all comparisons of fatalities and if studies are designed appropriately they allow the development of relationships with site characteristics and environmental variables, and evaluation of mitigation measures. At a minimum, fatality rates should be expressed on a per turbine and per MW basis, and other metrics may be used if the information is available, such as rotor swept hour or area.

2. What are the fatality rates of those species determined to be of special interest?

This analysis simply involves calculating fatalities per turbine of all species of interest at a site when sample sizes are sufficient to do so. These fatalities should be expressed on a per MW basis if comparing species fatality rates among facilities.

3. How do the estimated fatality rates compare to the predicted fatality rates?

There are a several ways that predictions can be assigned and later evaluated with actual fatality data. During the planning stages in Tier 2, predicted fatalities may be based on existing data at similar facilities in similar landscapes used by similar species. In this case, the assumption is that use is similar and therefore fatalities may be similar at the proposed facility. Alternatively, use metrics derived from pre-construction assessments for an individual species or group of species, usually an index of activity or abundance at a proposed facility, could be used in conjunction with use and fatality estimates from existing facilities to develop a model for predicting fatalities at the proposed facility. Finally, physical models can be used to predict the probability of a bird of a particular size striking a turbine and the probability, in conjunction with estimates of use and avoidance behavior can be used to predict fatalities.

Several statistical methods can be found in the revised methods and metrics document (citation coming soon) and used to evaluate fatality predictions. Metrics derived from Tier 3 pre-construction assessments may be correlated with fatality rates, and using the facility as the experimental unit, in Tier 5 studies it should be possible to determine if different preconstruction metrics can in fact accurately predict fatalities and, thus, risk.

4. How do the fatality rates compare to the fatality rates from existing facilities in similar landscapes with similar species composition and use?

Comparing fatality rates among facilities with similar characteristics is useful to determine patterns and broader landscape relationships and is discussed in some detail above for predicting fatalities at a proposed facility. Fatality rates should be expressed on a per MW or some other standardized metric basis for comparison with other facilities, and may be correlated with site characteristics such as proximity to wetlands, riparian corridors, mountain-foothill interface, or other broader landscape features using regression analysis. Comparing fatality rates from one project to fatality rates of other projects provides insight into whether a project has relatively high, moderate or low fatalities.

5. Do bird and bat fatalities vary within the facility in relation to site characteristics?

Turbine-specific fatality rates may be related to site characteristics such as proximity to water, forest edge, or other key resources and this relationship may be estimated using regression analysis. This information is particularly useful to determine future micro-siting options when planning a facility or, at a broader scale, in determining the location of the entire facility.

6. What is the composition of fatalities in relation to migrating and resident birds and bats at the site?

The most simplistic way to address this question is to separate fatalities per turbine of known resident species (e.g., big brown bat, prairie horned lark) and those known to migrate long distances (hoary bat, red-eyed vireo). These data are useful in determining patterns of species composition of fatalities and possible mitigation measures directed at either residents, migrants, or perhaps both and can be used in the assessment of potential population effects. More detailed investigations using stable isotope and genetic analyses may be conducted in Tier 5.

7. Do fatality data suggest the need for mitigation measures to reduce risk?

Fatality rates that trigger specific mitigation measures have not yet been established, but should be on a more local scale such as the state or by broad habitat types with similar risk levels (e.g., forested ridges) and related to local population effects. Evaluation of mitigation methods would occur in Tier 5, if there was uncertainty about whether the mitigation measure would meet the objective of reducing risk of fatalities.

2. Tier 5 – Other Post-construction Studies

Tier 5 studies are intended to assess both direct and indirect project-specific impacts, and may include: 1) estimating the direct and indirect effects (e.g., displacement) of habitat alteration, habitat loss, or habitat fragmentation on species of special interest, including birds, bats, and Federal or state-listed species; 2) analyzing factors associated with impacts, particularly direct impacts, in those cases in which impacts significantly exceed pre-construction predictions; 3) determining whether the avoidance, minimization, and mitigation measures implemented for a project were adequate or whether additional action is warranted; and 4) assessing demographic effects on local populations of species of special interest, including birds, bats, and Federal or state-listed species.

Studies to assess direct impacts may include quantifying species' habitat loss (e.g., acres of lost grassland habitat for grassland songbirds), and habitat modification. For example an increase in edge may result in greater nest parasitism and nest predation. Indirect impacts may include two important components. The first involves indirect effects to wildlife resulting from displacement, due to habitat fragmentation, loss, and alteration. The second involves demographic effects that may occur at the local, regional or population-wide levels. Such demographic effects may result from reduced nesting and breeding densities, loss of population vigor and/or decline in population density, habitat and site abandonment, increased isolation of species between habitat patches, loss of refugia for wildlife, attraction to modified habitats, effects on behavior (e.g., stress, interruption, and modification), disturbance, site avoidance, and displacement of species, and habitat unsuitability. These factors can individually or cumulatively affect wildlife, although some species may be able to habituate to some or perhaps all habitat changes. Indirect impacts may be difficult to quantify but their effects may be significant (e.g., Stewart et al. 2007, Pearce-Higgins et al. 2008, Bright et al. 2008, and Drewitt and Langston 2008).

Tier 5 studies may also be used by a developer to evaluate the effectiveness of a risk reduction measure (e.g., changes in turbine cut-in speed) before deciding to continue the measure permanently and/or whether to use the measure when implementing future phases of a project.

Occasionally, additional turbines may be proposed for an existing project resulting in site expansion. Results from Tier 4 and Tier 5 studies and the decision-making framework contained in the tiered approach can be employed to determine whether the project should be expanded and whether additional information, should be collected. It may also be necessary to evaluate whether additional measures to reduce impacts to species are necessary.

Adaptive management as defined earlier in this document may be useful in evaluating alternatives when design modifications and operational activities whether avoidance, minimization or mitigation measures fail to met desired goals. That is, Tier 5 studies may be proposed to test additional design and operation adjustments.

For example, if Tier 4 fatality studies document that a particular turbine or set of turbines exhibits greater bird or bat collision mortality than originally predicted, an appropriate response is an effort to identify the factors which cause or contribute to this higher level of impact, with a goal of identifying possible mitigation measures which might be tested in order to reduce the mortality. In this example, the decision to implement mitigation measures would be based on the likelihood of success in reducing mortality, the availability of alternative more cost effective measures, and the magnitude of concern over the increased level of fatalities.

<u>Post-Construction Study Designs</u>

A variety of designs may be utilized in Tier 5 studies, and the specific designs will depend on the types of questions and the specific project. Many Tier 5 studies will be a continuation of studies begun in Tier 3, and the decision to continue these studies in Tier 5 will reflect an assessment of the results of these Tier 3 studies. Like Tier 4 studies, results from Tier 5 studies should also lead to improved predictability and reduced cost of pre-construction risk assessment for future projects.

In the context of wind energy development, an alternate design for assessing displacement and/or other habitat-related impacts involves pre- and post-construction data collection on both project areas and reference areas, and this alternate design is most like the classic manipulative experiment[7]. The Before-After-Control-Impact (BACI) design is often considered an alternate design; the Impact Gradient Design is a modification of the classic BACI design (Morrison et al. 2008). The BACI, and perhaps the Impact Gradient Design, are initiated in Tier 3 and allow the strongest test of the impact of the wind project on the wildlife variables of interest, such as species displacement as a result of the project construction. Under the assumption that habitat and species use is homogenous in the assessment area prior to development, the Impact Gradient Design can provide an alternative to the BACI when before-data are lacking. Such designs will allow stronger inferences if multiple years of data collection occur in both pre- and post-

[7] In this context, such designs are not true experiments in that the treatments (project development and control) are not randomly assigned to an experimental unit, and there is often no true replication. Such constraints are not fatal flaws, but do limit statistical inferences of the results.

construction, and as a consequence post-construction studies utilizing alternate designs will be the most expensive type of study.

In many cases project impacts occur unexpectedly, and in such cases studies intended to understand these unexpected impacts would utilize alternate designs because relevant pre-construction data and/or reference areas may not be available. We recommend the use of alternate designs, such as BACI, if there is little information available from wind projects in similar landscapes involving similar species of concern. Alternative designs may be sufficient if there is post-construction data available from other sites involving similar landscapes and species.

Tier 5 questions

Tier 5 questions primarily focus on studies intended to evaluate impact predictions developed during the pre-construction risk assessment. For example, pre-construction studies focus on estimating the potential impacts of a wind project on wildlife, especially to species that are of special concern (e.g., state or Federally listed species), or species that are known to be at risk to wind development and are determined to be present in the proposed project area. As a result of these studies, design modifications to avoid or minimize predicted impacts and mitigation measures may be proposed. A goal of Tier 5 studies is to determine whether those modifications and measures have been effective in reducing predicted impacts, or whether estimated impacts exceed predictions requiring further mitigation and study.

Tier 5 questions typically fall in three major categories:

1. Do post-construction impacts equal or exceed pre-construction predictions for direct and indirect impacts on wildlife and their habitat determined to be of interest in Tier 3?

   In the Tier 3 risk assessment, predictions of collision fatalities and habitat impacts (direct and indirect) are developed. Post-construction studies in Tiers 4 and 5 evaluate the accuracy of those predictions by estimating impacts.

2. Have avoidance, minimization and /or mitigation measures implemented as part of the project to avoid unacceptably high direct and indirect habitat and fatality impacts been effective?

   If collision fatalities and habitat impacts exceed predictions, and/or they are unacceptably high, there may be additional or alternative avoidance, minimization and/or mitigation measures which should be explored. One objective of Tier 4 studies is to assess the effectiveness of mitigation measures implemented as part of the project and to identify such alternative or additional measures as are necessary. Question 2 refers to Tier 5 studies intended to evaluate the effectiveness of these measures.

3. Do the estimated impacts of the proposed wind energy project lead to local population declines in species of interest, and for selected species (e.g., rare and/or endangered species) to entire species and their habitats?

For species of interest identified in Tier 3 studies it is important to determine whether the estimated impacts of the wind project have population-level effects, typically measured as resulting in a population decline (lambda (λ) of less than 1). In most projects, this will be difficult to do beyond the local population, but in some cases, especially for listed species, the assessment of impact should include impact assessments for the entire species.

Tier 5 Methods

The specific Tier 5 questions and methods for addressing the above questions will depend on the specific project and the concerns raised during pre-construction studies and during operational phases. Because many of the Tier 5 studies are continuations of Tier 3 studies, the same techniques described in our description of Tier 3, e.g., avian use surveys, will be utilized. The case studies listed below provide examples of studies that have attempted to answer Tier 5 questions. Some of these examples are drawn from the updated Methods and Metrics document (*in preparation*) where more detailed discussion and case studies of alternate designs are available.

1. Indirect Impacts - Displacement Studies

Displacement refers to the indirect loss of habitat if birds avoid otherwise suitable habitat due to turbine operation and maintenance/visitor disturbance. Displacement can also result from fragmentation of habitat when birds are deterred from using normal routes to feeding or roosting grounds or large blocks of suitable habitat are broken into smaller blocks of less suitable habitat or where habitat fragmentation reduces reproductive success or survival of a wildlife species of special concern. As described in the methods for Tier 3, before-after/control-impact (BACI), resource selection function (RSF) and impact gradient, are the best study designs to estimate displacement effects, and the reader should refer to that section of the guidelines for more detail. The following example illustrates the use of alternate designs for the study of displacement.

Schaffer and Johnson (2008) examined displacement of grassland birds in the northern Great Plains. Intensive transect surveys were conducted within grid cells that contained turbines as well as reference areas. By using a grid, rather than a single transect, they were able to maximize the area surveyed associated with each turbine. Depending on the study area, distances out to 700 m to 1000 m from turbines were sampled. Surveys were conducted in both impact and reference areas prior to construction, so a BACI design was used to assess impacts. All focal species were mapped during the transect surveys. The authors compared observed versus expected distances to identify displacement effects. The study focused on five species at two study sites, one in South Dakota and one in North Dakota. Based on this analysis, killdeer (*Charadrius vociferous*), western meadowlark (*Sturna neglecta*), and chestnut-collared longspur (*Calcarius ornatus*) did not show any avoidance of wind turbines. However, grasshopper sparrow and clay-colored sparrow (*Spizella pallida*) showed avoidance out to 200 m.

2. Operational Modifications to Reduce Collision Mortality

Tier 5 studies may include more intensive post-construction mortality studies to determine, for example, relationships between fatalities and weather (e.g., wind speed) or turbine (revolutions-per-minute) covariates, which usually require daily carcass searches. Fatalities determined to have occurred the previous night can be correlated with that night's weather or turbine characteristics to establish important relationships that can then be used to evaluate the most effective times to implement operational modifications to reduce collision fatality. Other studies may use tools such as thermal imaging (Horn et al. 2008) or acoustic detectors (Kunz et al. 2007) to quantify post-construction bat activity in relation to weather and turbine characteristics for improving operational mitigation efforts. For example, at the Mountaineer project in 2003, Tier 4 studies (weekly searches at every turbine) demonstrated unanticipated and high levels of bat mortality (Kerns and Kerlinger 2004). Daily searches were instituted in 2004 and revealed that mortality was strongly associated with low-average-wind-speed nights, thus providing a basis for testing operational modifications (Arnett 2005, Arnett et al. 2008). The program also included behavioral observations using thermal imaging that demonstrated higher bat activity at lower wind speeds (Horn et al. 2008). These studies at Mountaineer and at a Pennsylvania site confirmed that wind projects located on Mid-Atlantic ridge-top could reasonably be expected to experience significant bat mortality (Arnett 2005). As a result, the Pennsylvania Game Commission has recommended more frequent carcass searches characteristic of Tier 5 studies (see PGC 2007).

Findings from intensive post-construction fatality studies can be used to determine optimal periods to implement operational modifications such as changes in turbine cut-in speed or real-time shutdowns to reduce collision fatalities. For example, Arnett et al. (2009) conducted studies on the effectiveness of changing turbine cut-in speed on reducing bat fatality at wind turbines at the Casselman Wind Project in Somerset County, Pennsylvania. Their objectives were to 1) determine the difference in bat fatalities at turbines with different cut-in-speeds relative to fully operational turbines, and 2) determine the economic costs of the experiment and estimated costs for the entire project area under different curtailment prescriptions and timeframes. Arnett et al. (2009) reported substantial reductions in bat fatalities with relatively modest power losses.

Iberdrola Renewables' Penascal project and Babcock & Brown's Gulf Wind project, both in Kenedy County, Texas, are collaboratively refining and testing a real-time curtailment protocol. The projects use a MERLIN avian profiling radar system to detect approaching "flying vertebrates" (birds and bats), primarily during spring and fall bird and bat migrations. The blades automatically idle when risk reaches a certain level and weather conditions are particularly risky. Feathering (real-time curtailment) experiments are underway in Tehuantepec, Mexico, where raptor migration through a mountain pass is extensive.

3. Assessment of Population-level Impacts

The Altamont Pass Wind Resource Area (APWRA) has been the subject of intensive scrutiny because of high avian mortality, especially mortality of raptors in an area encompassing more than 5,000 wind turbines (e.g., Orloff and Flannery 1992; Smallwood and Thelander 2004, 2005), and efforts to reduce mortality have met with limited success. Now about to begin the third year of a settlement agreement at APWRA, efforts to reduce avian mortality by 50% have as yet not been attained. Given the high mortality of certain long-lived raptors such as Golden

Eagle, concern has focused on the population-level impacts of this consistently high number of fatalities. To assess population-level effects, Hunt (2002) completed a four-year radio telemetry study of golden eagles at the APWRA and concluded that while the population is self-sustaining, fatalities resulting from wind-energy production were of concern because the population apparently depends on floaters from the local population and/or immigration of eagles from other subpopulations to fill vacant territories. Hunt conducted follow-up surveys in 2005 (Hunt and Hunt 2006) and determined that all 58 territories occupied by eagle pairs in 2000 were also occupied in 2005. Hunt (2002) hypothesized that this could be a sink population.

4. Displacement and Demographic Studies in Prairie Chickens

Researchers at Kansas State University, as part of the NWCC Grassland Shrub Steppe Species Collaborative (GS3C), have begun a multi-year radio telemetry study to evaluate effects of three proposed wind energy facilities on displacement and demographic parameters (survival, nest success, brood success, fecundity) of greater prairie chickens (*Tympanuchus cupido*) in Kansas. Studies are intended to evaluate whether 1) lek attendance is affected by wind-power development; 2) greater prairie-chickens avoid wind-towers and/or other anthropogenic features; and 3) wind energy development reduces nest success or chick survival. The study combines use of data collected at three proposed wind energy facilities and reference areas so that the BACI design can be used to assess effects on demographic parameters. Several hundred birds have been radio marked on all sites combined to obtain baseline data on both the reference areas and wind energy facilities. Birds are located frequently to determine home ranges and habitat use prior to wind energy developments so that displacement can be measured once the facilities are constructed. In addition, data are collected on survival of radio marked birds as well as nest success, fledgling success, and fecundity (the number of female offspring produced per adult female). The first post-construction data will be collected in 2009. Similar studies are being initiated to evaluate effects of wind energy development on greater sage-grouse in Wyoming.

F. Retrofitting

Retrofitting is defined as replacing portions of existing wind turbines or project facilities so that at least part of the original turbine, tower, electrical infrastructure or foundation is being utilized.

1. Retrofitting of turbines should use installation techniques that minimize new site disturbance, soil erosion, and removal of vegetation of habitat value
2. Retrofits should employ shielded, separated or insulated electrical conductors that minimize electrocution risk to avian wildlife
3. Retrofit designs should prevent nests or bird perches from being established in or on the wind turbine or tower
4. FAA visibility lighting of wind turbines should employ only red, or dual red and white strobe, strobe-like, or flashing lights, not steady burning lights.
5. Keep lighting at both operation and maintenance facilities and substations located within ½ mile of the turbines to the minimum required.
    a. Use lights with motion or heat sensors and switches to keep lights off when not

required.

   b. Lights should be hooded downward and directed to minimize horizontal and skyward illumination.
   c. Minimize use of high intensity lighting, steady-burning, or bright lights such as sodium vapor, quartz, halogen, or other bright spotlights.

6. Remove wind turbines when they are no longer cost effective to retrofit so they cannot present a collision hazard to birds and bats.

G. Repowering Existing Wind Projects

Repowering may include removal and replacement of turbines and associated infrastructure.

1. To the greatest extent practicable, existing roads, disturbed areas and turbine strings should be re-used in repower layouts.
2. Roads and facilities that are no longer needed should be stabilized and re-seeded with native plants appropriate for the soil conditions and adjacent habitat and of local seed sources where feasible, per landowner requirements and commitments.
3. Existing substations and ancillary facilities should be re-used in repowering projects to the extent practicable.
4. Existing overhead lines may be acceptable if located away from high bird crossing locations such as between roosting and feeding areas, or between lakes, rivers and nesting areas. Overhead lines may be used when they parallel tree lines, employ bird flight diverters, or are otherwise screened so that collision risk is reduced.
5. Above-ground low and medium voltage lines, transformers and conductors should comply with the 2006 or most recent Avian Power Line Interaction Committee (APLIC) “Suggested Practices for Avian Protection on Power Lines.”
6. Guyed structures should be avoided unless guy wires are treated with bird flight diverters or high visibility marking devices, or are located where known low bird use will occur.
7. FAA visibility lighting of wind turbines should employ only red, or dual red and white strobe, strobe-like, or flashing lights, not steady burning lights.
8. Keep lighting at both operation and maintenance facilities and substations located within ½ mile of the turbines to the minimum required.

   a. Use lights with motion or heat sensors and switches to keep lights off when not required.
   b. Lights should be hooded downward and directed to minimize horizontal and skyward illumination.
   c. Minimize use of high intensity lighting, steady-burning, or bright lights such as sodium vapor, quartz, halogen, or other bright spotlights.

H. Decommissioning

Decommissioning is the cessation of wind power operations and removal of associated equipment, roads, and other infrastructure. The land is then used for another activity. During decommissioning, contractors and facility operators should apply BMPs for road grading and native plant reestablishment to ensure that erosion and overland flows are managed to restore pre-construction landscape conditions. The facility operator, in conjunction with the landowner and state and federal wildlife agencies, should restore the natural hydrology and plant community to the greatest extent practical.

1. Decommissioning methods should minimize new site disturbance and removal of native vegetation, to the greatest extent practicable.
2. Foundations should be removed to a depth of two feet below surrounding grade, and covered with soil to allow adequate root penetration for native plants and so that subsurface structures don't substantially disrupt ground water movements.
3. If topsoils are removed during decommissioning, they should be stockpiled and used as topsoil when restoring plant communities. Once decommission activity is complete, topsoils should be restored to assist in establishing and maintaining preconstruction native plant communities to the extent possible
4. Soil should be stabilized and re-vegetated with native plants appropriate for the soil conditions and adjacent habitat and of local seed sources where feasible, per landowner requirements and commitments.
5. Surface flows should be restored to pre-disturbance conditions, including removal of stream crossings, roads, and pads.
6. Surveys, by qualified experts, should be conducted to detect invasive plants, and comprehensive approaches to controlling any detected plants should be implemented and maintained as long as necessary.
7. Overhead pole lines that are no longer needed should be removed.
8. After decommissioning erosion control measures should be installed in all disturbance areas where potential for erosion exists.
9. Fencing should be removed unless the land owner will be utilizing the fence
10. Petroleum product leaks and chemical releases that constitute a Recognized Environmental Condition should be remediated prior to completion of decommissioning.

Chapter Four: Compensatory Mitigation

The objectives of the activities described in Chapter Three are to avoid and minimize impacts to fish, wildlife and their habitats. However, if these measures are insufficient in avoiding or minimizing significant adverse impacts, then additional measures such as compensatory mitigation may be needed.

A. Compensatory Mitigation

Development of effective compensatory mitigation measures and recommendations should consider the USFWS Mitigation Policy and involve coordination with appropriate state agencies. Because a project's construction impacts on wildlife habitat cannot always be forecast with precision, it may not be feasible to make compensatory mitigation decisions until monitoring data is collected. However, the application, general terms, and commitments for potential future compensatory mitigation and the level of impact required for implementing such mitigation should be determined before a project goes forward, if possible. The method for implementing compensatory mitigation (e.g. fee title acquisition, in-lieu fee, conservation easement) should be determined early in the process if possible. If construction impacts exceed the expected and acceptable levels, additional compensatory mitigation may be necessary. Additional compensatory mitigation beyond that recommended prior to project construction should be well defined and feasible to implement, so that the developer will have an understanding of any potential future mitigation requirements.

The following potential compensatory mitigation options may appropriate for consideration:

- Offsite and on-site habitat restoration
- Offsite and on-site habitat creation
- Offsite and on-site habitat enhancement (and sometimes protection)

Regardless of the form of compensatory mitigation, there should be a nexus between the level of impact and the amount of mitigation. Any compensatory mitigation should be biologically based and reasonable.

B. Compensatory Mitigation Plans

For wind energy projects that pose significant adverse impacts to wildlife and their habitat, development of a formal compensatory mitigation plan may be warranted. These plans should be completed prior to project construction. Compensatory mitigation plans may not be necessary for low-risk projects or common species. If justified by the project's characteristics, a compensatory mitigation plan should include some or all of the following elements: mitigation measures, goals and objectives, implementation plan, performance standards, operation and maintenance plans, and monitoring and evaluation plans. Compensatory mitigation plans directed at bird and bat habitat may be included in an Avian and Bat Protection Plan (ABPP) designed to address project impacts to birds, bats and their habitats. A sample ABPP can be found in Appendix X.

C. Operational Modifications

The tiered approach incorporates post-construction fatality studies. These studies may indicate that a particular species has experienced significant adverse impacts (direct or indirect) greater than originally anticipated. This situation may result in additional or modifications to turbine operation. While many facilities may not require changes in operation, project locations that are considered high risk, as determined by the pre-construction studies, may require potential operational modifications, if feasible and supported by research. The facility operator can always coordinate with USFWS or states if operational modifications are not included initially as part of the project discussions.

Chapter Five: Advancing Use, Cooperation, and Effective Implementation of the Guidelines

The Committee recommends that USFWS collaborate and coordinate with other federal and state agencies to streamline and encourage consistent review of wind energy projects. USFWS should develop, maintain, and publish on their website a directory of BMPs that can be adopted by other federal and state agencies, and encourage consistent data collection and reporting while also addressing individual site circumstances and practical limitations. USFWS should also establish a process to allow the national guidance to be used by interested state and local governments.

A. Recommendations on Incentives for Use of Guidelines *(currently being drafted by Subcommittee):*

The Committee recommends that the USFWS establish several specific mechanisms to promote wind industry use of the recommended guidelines, as follows:

- ESA
- MBTA
- BGEPA
- Other?

The USFWS should contact the state wildlife agency prior to issuing any incentives or written assurance to give the state agency the opportunity to ensure project developers are considering state resources that may be at risk and state regulatory processes or mitigation requirements are being considered during project development.

B. Federal Interagency Coordination and Cooperation

USFWS should employ the following strategies to streamline the review and permitting process for wind projects by federal agencies:

1. Establish an interagency working group to optimize federal coordination and use of the USFWS national guidelines to the greatest extent possible, to advance consistency and avoid duplication in the federal review and permitting process as it relates to wind development.

2. USFWS should work with other federal agencies to provide incentives for adopting and using USFWS national guidelines, encourage early coordination for projects that may affect wildlife resources, and use interagency meetings to promote consistency.

3. USFWS should establish and maintain a readily accessible national repository of BMPs for wind/wildlife interactions to increase efficiency, interagency coordination, and state and industry use of best management practices.

4. USFWS should coordinate with other agencies that require data collection at a wind energy site to promote consistent methodology and reporting requirements, while also accommodating individual site conditions and practical limitations.

C. USFWS-State Coordination and Cooperation

USFWS should work with states to increase compatibility between state guidelines and these Guidelines, protocols, data collection methods, and requirements relating to wildlife and wind energy. While these Guidelines contain recommendations that are generally applicable at the federal, state and local levels across the country, some specific recommendations contained herein may not be accepted practices in all states. States that desire to or that have formally adopted wind energy siting, permitting or environmental review regulations or guidelines are encouraged to cooperate with USFWS to achieve consistency and to streamline wind project review.   USFWS should confer, coordinate and share its expertise with interested states when a state lacks its own guidance or program to address wind/wildlife interactions.

USFWS should establish a voluntary state/federal program to advance cooperation and compatibility between USFWS and interested state and local governments for coordinated review of wind projects under both federal and state wildlife laws. USFWS and interested states are encouraged to reach formal agreements to foster consistency in review of wind projects using the following tools:

- Cooperation agreements with interested state governments.

- Joint agency reviews to reduce duplication and increase coordination in project review.

- A communication mechanism
  - ✓ to share information about prospective wind projects,
  - ✓ to coordinate project review, and
  - ✓ to ensure that state and federal regulatory processes, and/or mitigation requirements are being adequately addressed.

- Identification of a lead state agency designated to work with the USFWS field office reviewing the project.

- Establishing consistent and predictable joint protocols, data collection methodology, and study requirements to satisfy wind project review and permitting.

- Designating a USFWS management contact within each regional office (or nationally) to assist field offices working with states and local agencies to resolve significant wildlife-related issues that cannot be resolved at the field level.

- Cooperative USFWS and state law enforcement efforts to identify and resolve violations of state and federal wildlife law applicable to wind projects.

- Cooperative state/federal/industry research agreements relating to wind project-wildlife interactions.

- **Additional Optional Arrangements between States and USFWS:**
  The Committee has developed a more formal model state/federal agreement document for possible use by states and USFWS (see appendix).

In administering this state/federal partnership program, the Committee recommends that USFWS and the states play differing but complementary roles:

USFWS Role

- Provide training to states
- Support a national database for reporting of mortality data on a consistent basis.
- Establish national BMPs for wind development projects
- Develop recommended guidance on study protocols, study techniques, and measures and metrics for use by all jurisdictions

- Assist in identifying and obtaining funding for national research priorities

States and Local Role

- Employ national guidance as a minimum foundation for state review of wind projects
- Report project monitoring data and results received from the project developer to a national database.

See Appendix --: *Sample Memorandum of Understanding Between USFWS and State*

D. USFWS-Tribal Coordination and Cooperation
(Currently being drafted)

E. USFWS-Developer Coordination and Cooperation (incomplete section: remainder is being drafted)

- Project-Specific Agreements

USFWS should encourage the negotiation of memoranda of understanding with interested project proponents in which USFWS could endorse a project plan in exchange for a developer's commitment to implement the voluntary guidelines, best management practices, and/or a plan to protect wildlife and their habitats (e.g. an ABPP). The agreement would provide written assurances by USFWS that compliance with the guidelines, best management practices, and/or ABPP will result in the focus of enforcement efforts on those who take migratory birds with disregard for their actions and the law, especially when conservation measures have been developed but are not properly implemented.
.

While each agreement would be tailored to the particular project, an agreement could include:

- A developer commitment to share all relevant information about wildlife resources in the project area and the potential impacts to these wildlife resources, including pre- and post construction study results related to the proposed project.

- A developer commitment to use due diligence to comply with USFWS guidelines and best management practices, subject to appropriate modification in consultation with USFWS.

- A USFWS commitment to focus its enforcement efforts on those who take migratory birds with disregard for their actions and the law, especially when conservation measures have been developed but are not properly implemented, provided the developer remains in compliance with the terms and conditions of the agreement and has made a good faith effort to avoid and minimize potential adverse impacts to wildlife and their habitat.

- A developer commitment to provide access, upon prior notice, to the wind energy project as requested by USFWS staff in order to ensure compliance with the agreement,.

F. Avian and Bat Protection Plans

USFWS should encourage use of Avian and Bat Protection Plans (ABPPs) as one of the important tools available to reduce risk to birds and bats and associated habitat in a project specific and/or company wide context (see Appendix ---- for further explanation). Based on compliance with an approved ABPP, USFWS would agree to focus its enforcement efforts on those who take migratory birds with disregard for their actions and the law, especially when conservation measures have been developed but are not properly implemented.

G. NGO Actions

There are a variety of non-governmental organizations that have an interest in improving siting procedures for wind energy projects, including supporting expanded wind energy development, and reducing wildlife impacts of wind energy development. Such groups do not have a formal role in assessing specific projects but can provide information that can (i) be useful to identify sensitive sites at the preliminary site screening phase, (ii) help to design mitigation or offset strategies that lead to faster project review and approval, or (iii) help define and fund research priorities that lead to improve predictions of risk and impact assessment and ultimately more cost-effective evaluation of wind project development that minimizes impact to wildlife.

Chapter Six: Revisions to the Guidelines

This document reflects the current state of knowledge about the interactions of wind turbines with birds, bats and wildlife in general. Ongoing and future research and actual experience in preliminary evaluation or screening of potential sites, site characterization, field studies to document site wildlife conditions and predict project impacts, and post-construction studies of wind energy projects will refine, expand and alter that knowledge. The Guidelines will be reviewed and revised, as necessary, approximately every five years. If substantive new information becomes available sooner, it should be used immediately and an addendum will be posted on the web-site updating the USFWS guidelines. Interested parties will have the opportunity to participate in the update and revision process. Consult the USFWS web page for information about proposed updates, revisions and participation: (www.fws.gov/habitatconservation/windpower/wind_turbine_advisory_committee.html). For questions about this document or to contribute information to the current body of knowledge, please contact the U. S. Fish and Wildlife Service at 703-358-2161.

Chapter Seven: Recommendations for Effective USFWS Administration of the Guidelines

A. Consistent Application

The Committee recommends that USFWS inform all Regional and Field staff of the premises and principles with which these Guidelines were developed. USFWS should provide guidance and training to the field for implementation of final USFWS guidelines to promote their consistent application, and to facilitate agency and industry understanding of recommended actions. Guidance should include the need for flexibility to address diverse geographic regions, habitat types, and wind energy development projects. USFWS should ensure that Regional and/or Washington office staff are available to provide guidance to the field for consistent application of the guidelines. Guidance also will be provided to assist in addressing developer concerns that cannot otherwise be resolved in a timely fashion at the field level.

USFWS should continue to be involved with the development of BMPs for project design, operation and compensatory mitigation, based on best available science, to minimize impacts to wildlife and their habitat from wind projects. BMPs will be reviewed periodically and revised as necessary to reflect new knowledge gained from current science, monitoring results, and experience with wind projects. All USFWS staff involved in review of wind projects should be trained in use of BMPs.

B. Training

USFWS should provide training to ensure that all Regional and Field staff have the knowledge, skill, and ability to implement the USFWS Guidelines. Training will be provided through hands-on workshops conducted in each USFWS Region, with priority for the first workshops to be scheduled in areas of high wind energy development activity. Each workshop should be open to participants from USFWS, industry, states, tribes and other appropriate participants, with the goal of developing partnerships to minimize impacts to wildlife and their habitat while allowing flexibility for wind energy development.

C. Staff support

USFWS should work within its budget constraints to provide staff support to review wind energy development projects in a timely and efficient manner. To supplement its staff efforts, USFWS should encourage state cooperative arrangements and participation in review of potential wind energy projects. USFWS encourages project proponents to coordinate early in the project development process to facilitate timely involvement and feedback. USFWS should also explore the collocation of additional staff in Bureau of Land Management Pilot Offices for renewable energy, and the creation of new collocated renewable offices. USFWS should continue to explore cutting edge technology to further streamline the review process.

D. Research

Bird and bat interactions with wind turbines is an area of active research and collaboration. USFWS should promote collaboration and information sharing with research efforts to advance science on wind/wildlife interactions. Subject to funding, USFWS should work with other federal agencies, stakeholders, and states to develop a national research plan to identify research priorities to reduce impacts to wildlife resources while allowing wind energy development. The research plan should include major research issues and recommendations for support of specific research activities. The plan can be used to identify leveraging opportunities and support collaborative research efforts.

List of Appendices (*Appendices are in a separate handout for FAC review)*

Please see the FAC website for the Other Models Subcommittee Matrix from October 21-23, 2008: *www.fws.gov/habitatconservation/windpower/wind_turbine_advisory_committee.html*

A. WTGAC Legal Subcommittee White Paper October 21-23, 2008

B. WTGAC Landscape/Habitat Subcommittee, "Mapping Tools Case Studies" October 21-23, 2008

C. WTGAC Landscape/Habitat Subcommittee, Summary of Metadata for Data Layers Mapped, October 21-23, 2008

D. WTGAC Existing Guidelines Subcommittee Recommendations, October 21-23, 2008

E. First Draft Recommended Elements of an Avian and Bat Protection Plan, October 21-23, 2008

F. Glossary