Bird and Bat Risk Assessment:

Assessing Risk to Birds and Bats at the Proposed Wild Meadows Wind Project, Merrimack and Grafton Counties, New Hampshire

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Executive Summary

An Ecological Risk Assessment was performed by Stantec Consulting Inc. (Stantec), in 2012 to evaluate potential impacts to avian and bat resources from both the construction and operation of the proposed Wild Meadows Wind Project (the Project) in Grafton and Merrimack Counties, New Hampshire. The assessment used information from literature review, agency consultation, regional surveys and databases, and on-site field surveys to characterize use of the Project area by raptors, nocturnally migrating passerines, breeding birds, and bats. Field surveys used in preparing the risk assessment included: acoustic bat surveys and nocturnal radar surveys conducted in fall 2009; raptor migration surveys, acoustic bat surveys, nocturnal radar surveys and breeding bird surveys conducted in spring 2010; raptor migration surveys conducted in fall 2010; and a mist net survey and northern long-eared bat habitat assessment conducted in 2011. Detailed descriptions of methods and results of these surveys are provided in separate seasonal survey reports (Fall 2009 Radar and Acoustic Surveys [Stantec 2011a], Spring 2010 Avian Bat Survey Report [Stantec 2011b], 2010 Spring and Fall Raptor Migration Surveys [Stantec 2011c], 2011 Mist Net Survey Report [Stantec 2012a], and 2011 Northern Long-eared Bat Habitat Assessment [Stantec 2012b])). Work scopes and levels of effort for field surveys were determined based on Stantec's experience conducting these types of surveys at proposed wind projects in the northeast as well as consultation with the New Hampshire Fish and Game Department (NHFGD), US Fish and Wildlife Service (USFWS), and The Audubon Society of New Hampshire (NH Audubon). A work plan detailing the methods of the field surveys were discussed with NHFGD and USFWS and approved at a meeting in Condcord, NH on April 1, 2010.

It is currently not possible to definitively quantitatively assess risk to birds and bats in the pre-construction phase, given the existing technology and methodologies available. Therefore, a qualitative weight-of-evidence technique was used in this risk assessment. This assessment was modeled after the method developed by the Massachusetts Weight-of-Evidence Workgroup (hereafter workgroup), an independent *ad hoc* group of ecological risk assessors from both government and private sectors (Massachusetts Weight-of-Evidence Workgroup 1995). The workgroup drafted a guidance document to provide standardized terminology and methodology for implementing a WOE approach. This document, as well as the U.S. Environmental Protection Agency's (USEPA) Framework for Ecological Risk Assessment (USEPA 1992), serve as the basis for the approach used to assess risk to bats and birds from the development and operation of the proposed Project. Using this technique, the results of field surveys, regional data, and literature review were evaluated for their indication of risk to birds and bats from direct and indirect impacts. The strengths and weaknesses of each source of data were also evaluated to assign a level of confidence or certainty to the assessment of risk derived from each type of data. The weight-of-evidence approach has been used for other risk assessments for wind projects in the region, and is an agency-accepted approach to assessing risk.

While statements of risk included in this report are made with some uncertainty, results from the weight-of-evidence assessment provide a thorough summary of the current understanding of potential risks to raptors, nocturnally migrating passerines, breeding birds, and bats. The document is organized around these four species groups. Each is addressed separately within the results and discussion sections.

Potential impacts to raptors are expected to be low (i.e., relatively few individuals impacted), based on the finding that very few raptors have collided with turbines at existing facilities throughout the country (with the exception of older facilities in California, such as Altamont Pass Wind Resource Area), and relatively low numbers of raptors appear to pass over the Project area during the spring and fall migration periods. While the Project area does not support nesting eagles, bald eagles (*Haliaeetus leucocephalus*) appear to be occasionally present in the vicinity of the Project area during the spring and fall migration periods, and - while not observed during field surveys for the Project - golden eagles (*Aquila chrysaetos*) are known to occur in the region during migration. However, based on publicly available post-construction surveys, eagles have not been documented to collide with wind turbines at any New England projects.

Based on the nocturnal radar survey results, nocturnally migrating passerines were observed to migrate through the Project area in relatively moderate to high numbers, although the vast majority of individuals were flying high above the proposed turbine height, and a relatively small percentage of individuals passed below the turbine height. Among the categories of birds discussed in this document, nocturnally migrating passerines are expected to be vulnerable to collision, including those birds passing within the rotor-swept zone, given their apparent abundance during spring and fall migration and results of post-construction mortality monitoring at existing wind projects. However, it is expected that passerine collision rates at this project will be similar to operational projects in New England where mortality has been relatively low, because nocturnal migration of passerines is broad front over the region and the Project shares similar landscape and project design features as these operational projects.

Potential impacts to breeding birds are expected to be minimal (i.e., would not represent a population-level impact for any one species). While collision mortality has been documented for breeding birds at existing facilities, birds seem to be less prone to collision during the breeding season than during the spring and fall migration. Indirect impacts to breeding birds associated with habitat conversion are expected to cause limited shifts in species distribution and abundance and are expected to affect certain species more than others. Breeding bird habitat currently within the Project area consists of a mosaic of second growth and successional forest with a history of timber harvests. While many of the species documented at the Project are often found in fragmented habitats, certain forest interior species may be indirectly impacted by the Project. However, overall indirect impacts to breeding birds are expected to be minimal, and the type of clearing associated with the Project is not expected to dramatically alter the breeding bird community in the Project area. Furthermore, no federally or state listed threatened or endangered species were observed in the Project area during breeding bird surveys.

Results of the risk assessment suggest that potential impacts to bats consist largely of collision mortality, particularly during the fall migration season. While collision mortality has been documented at operational wind facilities during summer, and bats reside within the region between early spring and late fall, bats seem most vulnerable to collision during the fall migration period based on results from post-construction surveys at existing facilities. Long distance migratory species are expected to be more vulnerable to collision mortality than other species based on these post-construction studies. These species were well represented in the results of on-site acoustic surveys, particularly at high detectors (i.e., heights approaching the lower range of the rotor-swept zone). This finding, combined with the fact that long-distance migratory bat species have comprised the majority of fatalities at several operational facilities, suggests that long-distance migratory bat species may be the group of bats most vulnerable to collision mortality. However, it is expected that bat collision rates at this Project will be similar to operational projects in New England where bat mortality has been relatively low, because the patterns of bat fatality have been generally similar across the region and the Project shares similar landscape and project design features as these operational projects. To date, post construction mortality surveys in the northeast, including New England, have documented a greater proportion of long distance migratory bat fatalities, particularly silver-haired bats (*Lasionycteris noctivagans)* and hoary bats (*Lasiurus cinereus)* than those species that tend to migrate shorter distances, such as *Myotis* species.

Overall, the impacts to birds and bats expected at the Project are expected to be similar to those generally associated with wind power projects in the eastern United States, and most similar to those in New England. Habitats at the Project are typical of northern hardwood – conifer forest, which is the most common forest community in the northern half of the State of New Hampshire. Conifer species such as red spruce (*Picea rubens*) and balsam fir (*Abies balsamea*) are present, but are generally limited to the ridge summits. Potential ecological impacts are expected to be within the range of those documented at existing wind facilities in the east, particularly those in New Hampshire and Maine, which have been shown to be relatively low. Relatively speaking, nocturnally migrating songbirds and bats are expected to be more vulnerable to collision mortality at the Project, especially during the fall migration period when passage rates were found to be greatest during field surveys; however, impacts to nocturnal migrant passerines are expected to be low because the species most frequently involved in collisions at existing projects are regionally abundant, and impacts to bats are expected to be low to moderate based on the results of other projects in the region.

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List of Acronyms

Atlantic Wind	Atlantic Wind LLC
BBA	Breeding Bird Atlas
BBS	Breeding Bird Survey
Birds/hr	birds per hour
BNA	Birds of North America
b/t/sp	Birds or bats per turbine per study period
b/t/yr	Birds or bats per turbine per study year
CBC	Christmas Bird Count
EOS	Eastern observation point
ERA	Ecological Risk Assessment
ESA	Endangered Species ACt
Groton	Groton Wind Farm
HMANA	Hawk Migration Association of North America
IBA	Important Bird Area
kW	Kilowatt
NH Audubon	The Audubon Society of New Hampshire
NHFGD	New Hampshire Fish and Game Department
NHGB	Grafton-Bristol New Hampshire count circle
NH NEWP	New Hampshire Nongame and Endangered Wildlife Program
NH PIF	New Hamsphire Partners in Flight Working Group
NWCC	National Wind Coordinating Committee
Project	Wild Meadows Wind Project
RTE	Rare, Threatened, or Endangered
Stantec	Stantec Consulting Inc.
t/km/hr	Targets per kilometer per hour
USGS	United States Geological Survey
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
WNS	White-nose Syndrome
WOE	Weight-of-Evidence
WOS	Western observation point
Workgroup	Massachusetts Weight-of-Evidence Workgroup

1.0 Introduction

Atlantic Wind LLC (Atlantic Wind) is evaluating the proposed Wild Meadows Wind Project (Project) in Grafton and Merrimack Counties, New Hampshire. The Project would include the installation of 23 wind turbines to be located on Tinkham and Braley Hills, The Pinnacle, and Forbes Mountain; a permanent meteorological (met) tower on Forbes Mountain; and associated infrastructure (e.g., access roads, transmission, electrical substation, and operations and maintenance building) (Figure 1-1). The turbines will be 3.3 megawatt (MW) machines mounted on tubular steel towers with an approximate hub height of 94 meters (m; 308 feet [']) and a rotor diameter of 112 m (367'). The proposed turbines will have a maximum tip height of approximately 150 m (492').

Potential ecological impacts to birds and bats associated with wind projects can be divided into two primary categories: direct impacts involving collision mortality with turbine blades, towers, and associated structures, and indirect impacts such as habitat loss and displacement from areas containing turbines. In an effort to assess potential impacts to birds and bats at the proposed Project, Atlantic Wind consulted with the New Hampshire Fish and Game Department (NHFGD) and the U.S. Fish and Wildlife Service (USFWS) at a meeting in Concord, New Hampshire on April 1, 2010. At this meeting, a proposed work plan documenting methods for standard pre-construction surveys were discussed (i.e., radar, raptor, acoustic bat, and breeding bird surveys), and NHFGD recommended adding additional surveys (bat habitat assessment, literature review, and mist netting; additional surveys for American marten will not be discussed in this document). The work plan was subsequently revised to incorporate these additional surveys. A second meeting with NHFGD, Atlantic Wind, and Stantec occurred on March 31, 2011, to discuss the level of effort, protocol, and survey locations for mist netting surveys.

Following the details of the work plan, Stantec and the Audubon Society of New Hampshire (NH Audubon) conducted a variety of field surveys for birds and bats in the Project area. Stantec's seasonal survey reports were revised August 2012 after the turbine type and layout for the Project were finalized. Methods, results, and discussion of each survey are summarized in detail in the seasonal survey reports:

- Fall 2009 Radar and Acoustic Surveys (Stantec 2011a);
- Spring 2010 Avian and Bat Survey Report (Stantec 2011b);
- 2010 Spring and Fall Raptor Migration Surveys (Stantec 2011c);
- 2011 Mist Net Survey Report (Stantec 2012a); and
- 2011 Northern Long-eared Bat Habitat Assessment (Stantec 2012b).

Following analysis of the results of on-site field surveys, Stantec reviewed available information regarding the abundance, distribution, and species composition of birds and bats in the Project area, synthesized this information with results of on-site surveys, reviewed known patterns of collision mortality at wind farms for each group, and finally incorporated this information into this risk assessment.

The purpose of this document is to provide a summary of information obtained from literature review, agency consultation, and site-specific pre-construction field surveys to evaluate potential impacts to birds and bats from construction and operation of the Project. The primary species groups discussed in this assessment are raptors, nocturnally migrating passerines, breeding birds, and bats. The document is organized around these four species groups, which are further divided into sections discussing particular species and/or guilds within the group.

Unlike traditional ecological risk assessments, in which a stressor is present in a measurable quantity and potential effects of this stressor on various species or communities have been described, risk assessments for wind energy involve a stressor that is not yet present in the landscape (wind turbines), and, therefore, risk cannot be predicted in a quantitative manner. However, the risk assessment approach provides a framework for systematic analysis and standardized documentation that elucidates the factors considered in the evaluation process. This risk assessment was modeled after the method developed by the Massachusetts Weight-of-Evidence Workgroup (hereafter workgroup), an independent *ad hoc* group of ecological risk assessors from both government and private sectors (Massachusetts Weight-of-Evidence Workgroup 1995). The workgroup drafted a guidance document to provide standardized terminology and methodology for implementing a WOE approach. This document, as well as the U.S. Environmental Protection Agency's (USEPA) Framework for Ecological Risk Assessment (USEPA 1992), serve as the basis for the approach used to assess risk to bats and birds from the development and operation of the proposed Project. This document will serve as a screening-level, modified ecological risk assessment (ERA) and follows a conservative, qualitative approach to predicting levels of risk to various bird and bat species. This approach uses a weight-of-evidence (WOE) framework that simultaneously evaluates multiple, diverse survey methods and considers the strengths and weaknesses of each. Level of risk for each species or group evaluated is predicted by taking into account its abundance in the Project area, the likelihood of exposure to wind turbines, and patterns of impact to the particular species or group, as documented at existing wind projects. The WOE approach was selected for this risk assessment because it is well-suited to make the most appropriate use of a variety of types of data with ranging quality and applicability, and was identified as a frequently used method in a draft document prepared by the National Wind Coordinating Committee (NWCC) on the applicability of ERA to wind projects (Kunz 2007b). The weight-of-evidence approach has been used for other risk assessments for wind projects in the region, and is an agency-accepted approach to assessing risk.

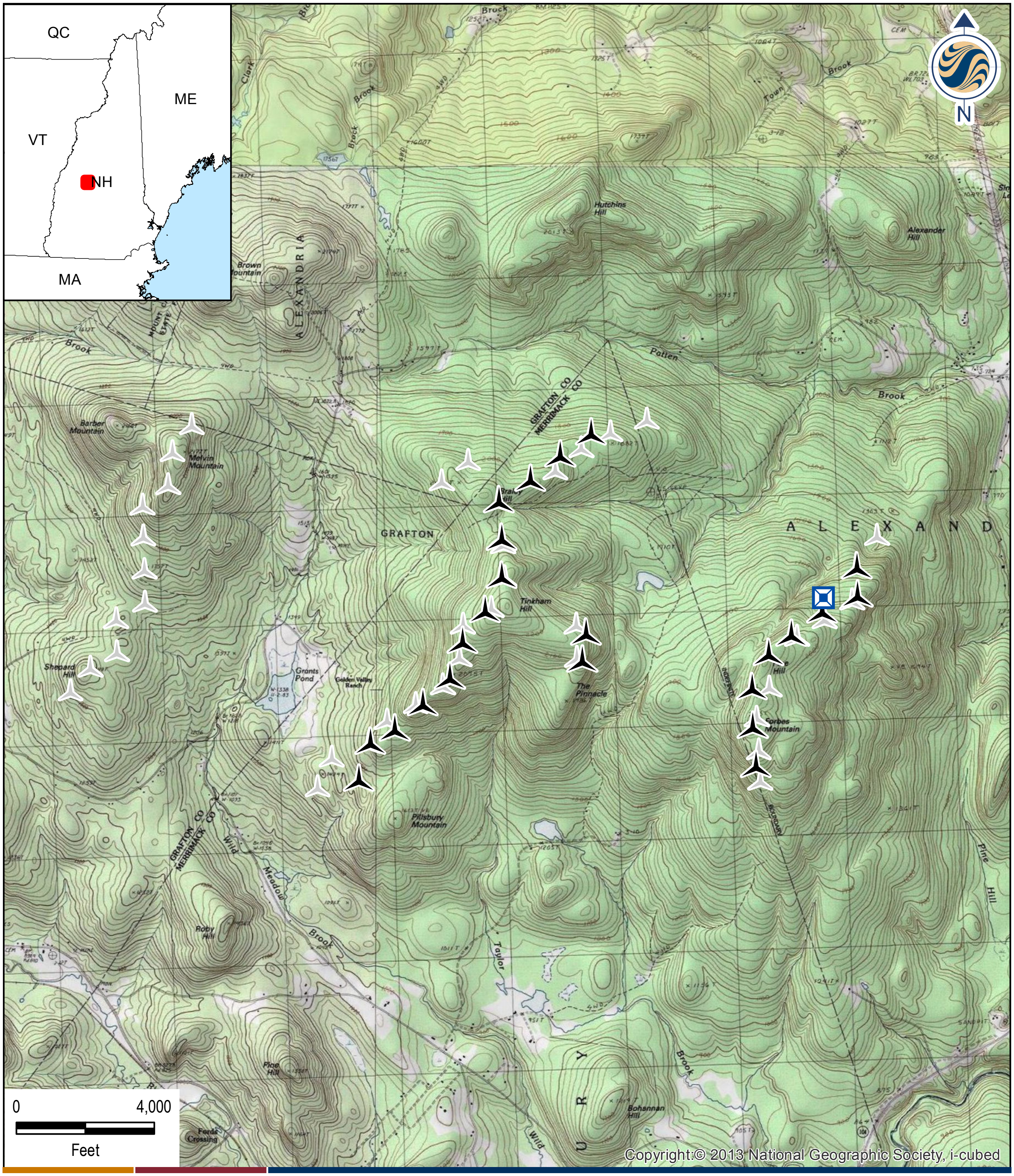
Although risk assessments have not typically been included as part of the permitting process for wind projects in New England, the WOE approach has been used by Stantec to assess risk at other projects in New England (Groton Wind Project, New Hampshire; Rollins Wind Project, Maine; and Kingdom Community Wind, Vermont) and two projects in the Mid-Atlantic (Laurel Mountain and New Creek, both in West Virginia) (Stantec 2009b, Stantec 2009c, Stantec 2010a, Stantec 2008c, and Stantec 2008b). This approach has been accepted by the regulatory agencies in those states. This assessment provides a standardized approach to assessing risk to birds and bats from the project by incorporating a variety of lines of evidence and the strengths and weaknesses of them. Overall, it provides descriptions of each line of evidence used and the process in which conclusions of risk were reached.

1.1 PROJECT AREA DESCRIPTION

Based upon defined ecoregions of northern New England and New Hampshire, the Project is located within the Vermont-New Hampshire Upland section and the Sunapee Uplands subsection (Sperduto and Nichols 2004). The Sunapee Uplands subsection is characterized by hills and peaks, principally of granite, that are interspersed with small lakes and narrow stream valleys (Sperduto and Nichols 2004). Topography of this area is generally moderate, and soils are stony, shallow and nutrient poor.

Peaks located partially or entirely within the Project include Braley Hill (635 m; 2,083'), Tinkham Hill (692 m; 2,270'), and The Pinnacle (604 m; 1981'). Eastern portions of the Project include Forbes Mountain (658 m; 2159'), and Pine Hill (638 m; 2,091'). Previously, Barber Mountain (651 m; 2,136'), Melvin Mountain (660 m; 2,165'), and Sheppard Hill (550 m; 1,640') were within the western portion of the Project area; however, as of September 2013 they are no longer included. Some of the field survey locations were located in this former part of the Project area.

Because of the moderate elevation, the dominant tree species in the Project area are hardwood species including sugar maple (*Acer saccharum*), yellow birch (*Betula alleghaniensis*), and American beech (*Fagus grandifolia*). These tree species are typical of northern hardwood – conifer forest, which is the most common forest community in the northern half of the state of New Hampshire. Conifer species such as red spruce (*Picea rubens*) and balsam fir (*Abies balsamea*) are present, but are generally limited to the ridge summits. On the majority of Project ridgelines, conifer species are mixed with the more dominant hardwood species, or occur as small patches within the hardwood dominated landscape. Common understory species include regenerating canopy species (e.g., sugar maple, yellow birch, and American beech), hobblebush (*Viburnum lantanoides*), striped maple (*Acer pensylvanicum*), and white birch (*Betula papyrifera*). The Project area ridgelines all show signs of timber harvesting activities as evidenced by skidder trails and clear cuts in various stages of regeneration.



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Legend

Proposed Turbine (9/3/2013)

Previously Proposed Turbine (9/24/12)

Permanent MET Tower (9/3/2013)

Client/Project

Atlantic Wind LLC
Wild Meadows Project
Merrimack & Grafton Counties, New Hampshire

Figure No.

1-1

Title

Project & Turbine Location Map

November 15, 2012
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2.0 Methods

2.1 INFORMATION REVIEW

For each avian and bat species group discussed in this ERA, Stantec reviewed available sources of data on distribution, abundance, and species composition in the vicinity of the Project area. These included online databases, literature review, agency consultation, regional survey data, and on-site field surveys. Results from Christmas Bird Counts (CBC), North American Breeding Bird Survey (BBS) routes, The Breeding Bird Atlas (BBA), the Cornell Lab of Ornithology and National Audubon Society's online checklist program (eBird), and Hawk Migration Association of North America (HMANA) counts were also reviewed. The quantity, quality, and relevance of obtained data varied by species group. Specific types of information used for each group are identified in the corresponding results sections of this report.

2.2 FIELD SURVEYS

A variety of on-site field surveys were conducted in the Project area between August 2009 and August 2011. Surveys were conducted primarily during the spring and fall migration periods, and included raptor, nocturnal marine radar, breeding bird, acoustic bat, and summer bat mist-net surveys. Dates of various field surveys conducted in the Project area are summarized in Table 2-1.

Table 2-1. Timing and level of effort for avian and bat field surveys conducted in and in vicinity of the Project area.

Survey Type	Range of Dates	# Survey Days (or nights)	# Locations Sampled	Source
Spring 2010 Raptor Survey	4/15/10 to 5/26/10	10 days per site, 20 total observation days	2 locations simultaneously sampled	2010 Spring and Fall Raptor Migration Surveys (Stantec 2011c)
Fall 2010 Raptor Survey	9/14/10 to 10/13/10	10 days per site, 20 total observation days	2 locations simultaneously sampled	2010 Spring and Fall Raptor Migration Surveys (Stantec 2011c)
Fall 2009 Nocturnal Radar Survey	8/20/09 to 10/15/09	35 nights	1 radar location	Fall 2009 Radar and Acoustic Surveys (Stantec 2011a)
Spring 2010 Nocturnal Radar Survey	4/15/10 to 5/26/10	33 nights	1 radar location	Spring 2010 Avian and Bat Survey Report (Stantec 2011b)
2010 Breeding Bird Survey	6/2/10 to 6/16/10	2 rounds of surveys, 4 days total	27 point-count locations	Spring 2010 Avian and Bat Survey Report (Stantec 2011b)
Fall 2009 Bat Acoustic Survey	8/19/09 to 10/22/09	65 calendar nights, 178 detector-nights	3 detector locations	Fall 2009 Radar and Acoustic Surveys (Stantec 2011a)
2010 Bat Acoustic Survey	4/8/10 to 8/19/10	134 calendar nights, 1,097 detector-nights	9 detector locations	Spring 2010 Avian and Bat Survey Report (Stantec 2011b)
2011 Bat Mist Net Survey	6/26/11 to 8/8/11	10 nights	5 sites	2011 Mist Net Survey Report (Stantec 2012)

Methods and work scopes for surveys conducted in the Project area were based on a combination of standard methods within the wind power industry for pre-construction surveys, and input and guidance from NHFGD, USFWS, and NH Audubon. Surveys were consistent with several other studies conducted recently in the state and the Northeast region including the three operational or permitted projects in NH. This document has been prepared at the request of Atlantic Wind and serves as an overall synthesis of survey results and available information from other publicly available surveys at proposed or existing wind projects in the eastern United States. Detailed descriptions of the survey methods and results of surveys included in Table 2-1 are summarized in corresponding survey reports, and are not reiterated in this document.

Although Stantec did not conduct formal habitat surveys as part of its fieldwork, this risk assessment includes general information about habitat types present within the Project area. This information was obtained during on-site surveys which all involved hiking and/or driving throughout most of the Project area. Throughout this report, “habitat characterizations” refer to information recorded by Stantec during fieldwork in the Project area between 2009 and 2011, and are limited to general, qualitative observations.

2.3 RISK ASSESSMENT

Information gathered for each primary category (raptors, nocturnally migrating passerines, breeding birds, and bats) during the information review process and on-site field surveys was incorporated into this risk assessment. Although risk assessments used in different fields of study are variable in scope and focus, they often share a common framework with consistent terms used to describe key concepts. Because these terms can be technically complex, the following outlines vocabulary used to describe key components of this risk assessment.

Weight-of-Evidence (WOE) is the process by which multiple measurement endpoints are related to an assessment endpoint to evaluate risk. An **assessment endpoint** is a “…quantitative or quantifiable expression of the environmental value considered to be at risk…” from a given stressor (Suter 1993) (e.g., the potential collision mortality of a species, or potential loss of habitat for a species). **Measurement endpoints** are the methods used to estimate the effects of exposure on an assessment endpoint (e.g., literature review and nocturnal radar surveys, and literature review and breeding bird surveys, respectively, for the examples provided). **Potential stressors** evaluated at wind facilities can include moving or stationary turbine blades, monopoles, habitat removal and fragmentation, behavioral effects, or human activity leading to disturbance, among others (Leddy *et al.* 1999). Specific measurement endpoints, assessment endpoints, and stressors for each species category are identified in corresponding subsections of the results section.

A WOE model is a central component of the Ecological Risk Assessment that takes into account the strengths and weaknesses of different measurement endpoints. Within this model, lines of evidence that yield high quality, relevant data for a particular ERA are assigned more “weight” than lines of evidence that may be less relevant, or less accurate. This approach is particularly well-suited for an ERA involving multiple measurement endpoints with varying degrees of relevance to particular assessment endpoints, which is typically the case with pre-construction surveys at proposed wind projects. The WOE approach will not eliminate discrepancies in the quality or relatedness of the sources of data, but rather evaluates each source of data in a systematic manner. Professional judgment, along with scientific knowledge and technical expertise, are applied in the evaluation of multiple lines of evidence pertaining to a specific assessment endpoint. The WOE model provides a comprehensive strategy for integrating disparate assessment methods into a cohesive framework that facilitates the interpretation of results.

The procedure used in this risk assessment was modeled after the method developed by the Massachusetts Weight-of-Evidence Workgroup (hereafter workgroup), an independent *ad hoc* group of ecological risk assessors from both government and private sectors (Massachusetts Weight-of-Evidence Workgroup 1995). The workgroup drafted a guidance document to provide standardized terminology and methodology for implementing a WOE approach. This document, as well as the U.S. Environmental Protection Agency's (USEPA) Framework for Ecological Risk Assessment (USEPA 1992), serve as the basis for the approach used to assess risk to bats and birds from the development and operation of the proposed Project.

The WOE approach followed in this document was organized around four primary processes. First, assessment and measurement endpoints were defined for each species category to best address potential impacts within that category and allow for discussion of risk to certain subgroups separately. For example, potential impacts to Rare, Threatened and Endangered (RTE) bird species was treated as a separate assessment endpoint from risk of collision to non-listed bird species within the bird section. Measurement endpoints typically consisted of each type of data available or survey conducted on-site to address a particular assessment endpoint. In some cases, certain similar types of information, such as a variety of types of regional information on abundance of breeding birds, were combined into a single measurement endpoint.

Second, weight was assigned to each measurement endpoint, based on a series of ten criteria considered equally important in evaluating measurement endpoints (Massachusetts Weight-of-Evidence Workgroup 1995). The ten attributes are divided into three categories: 1) strength of association between assessment and measurement endpoints; 2) data quality; and 3) study design and execution (Table 2-2). Each measurement endpoint was scored according to each of the ten attributes, resulting in an overall score of high, medium, or low based on broadly applicable, non-overlapping criteria presented in a document prepared by the WOE workgroup (Massachusetts Weight-of Evidence Workgroup 1995). These criteria are identified in Table 2-3. While the criteria contained in Tables 2-2 and 2-3 are more appropriate for use in traditional risk assessments involving stressors present in a system in a measurable quantity, they were applied to the endpoint pairs used in this risk assessment as appropriately and consistently as possible.

Third, each measurement endpoint was evaluated with respect to its indication of risk of harm and the magnitude of this risk. Indication of risk of harm for each measurement/assessment endpoint pair was described as "yes" (potential impact exists), "no" (potential impact does not exist), or "undetermined." For endpoint pairs where a potential impact was determined to exist, the magnitude of response was characterized has "high," "moderate," or "low," depending on the predicted severity of impact.

Finally, the level of concurrence among measurement endpoints was evaluated to determine whether or not various measurement endpoints generally predicted similar levels and magnitudes of risk. This was done by plotting each measurement endpoint on a matrix, the columns of which present the weights assigned in the first step, and the rows of which present the likelihood of risk based. Agreements or divergences among measurement endpoints are readily observed using this matrix, enabling interpretation of the results of various survey methods with respect to particular assessment endpoints. Within this report, assessment and measurement endpoints are identified and evaluated in the results section, and the remainder of the steps previously described is contained in the discussion section, organized by the four species categories in both sections.

Table 2-2. Definitions of attributes used to determine the "weight" of measurement endpoints (Massachusetts Weight-of-Evidence Workgroup 1995).

	Attributes	Measurement Endpoint
I. Strength of Association between Measurement and Assessment Endpoints		
1	Degree of Biological Association	The extent to which the measurement endpoint is representative of, and correlated with, or applicable to the assessment endpoint. Biological linkage is based on known biological processes; similarity of effect, target organism, mechanism of action, and level of ecological organization.
2	Stressor/Response	The ability of the endpoint to demonstrate effect from exposure to the stressor and to correlate effects with the degree of exposure. As such, this attribute also takes into consideration the susceptibility of the receptor and the magnitude of effects observed.
3	Utility of Measure	This attribute relates the ability to judge results of the survey against well-accepted standards, criteria, or objective measures. As such, the attribute describes the applicability, certainty, and scientific basis of the measure, as well as the sensitivity of a benchmark in detecting environmental harm.
II. Data Quality		
4	Data Quality	The degrees to which data quality objectives are designated that are comprehensive and rigorous, as well as the extent to which they are met. Data quality objectives should clearly evaluate the appropriateness of data collection and analysis practices. If any data quality objectives are not met, the reason for not meeting them and the potential impact on the overall assessment should be clearly documented.
III. Study Design and Execution		
5	Site Specificity	The extent to which biological data, environmental conditions, or habitat types used in the measurement endpoint reflect the site of interest.
6	Sensitivity	The ability to detect a response in the measurement endpoint, and the ability to discriminate between responses to a stressor and those resulting from natural or design variability and uncertainty.
7	Spatial Representativeness	The degree of compatibility or overlap between the locations of measurements or samples, locations of stressors, and locations of ecological receptors and their potential exposure.
8	Temporal Representativeness	The degree of temporal overlap between the measurement endpoint (when data were collected) and the period during which effects of concern would be likely to be detected. Also linked to this attribute is the number of measurement or sampling events over time and the expected variability over time.
9	Quantitative Measure	This attribute relates to whether magnitude of response can be assessed objectively or subjectively, and whether the results can be tested for both biological and statistical significance.
10	Standard Method	The extent to which the study follows standard protocols recommended by a recognized scientific authority for conducting the method correctly. Examples of standard methods are study designs repeatedly published in the peer reviewed scientific literature. This attribute also reflects the suitability and applicability of the method to the endpoint and the site, as well as the need for modification of the method.

Table 2-3. Criteria for qualitatively ranking measurement endpoints (Massachusetts Weight-of-Evidence Workgroup 1995).

Attribute		Measurement Endpoint Ranking Criteria		
		LOW	MEDIUM	HIGH
1	**Biological linkage between measurement endpoint and assessment endpoint**	Biological processes link the measurement endpoint to the assessment endpoint only indirectly, yielding a weak correlation between the assessment and measurement endpoints	Measurement and assessment endpoints are directly linked and the adverse effect, target organism, and mechanism of action are the same for both endpoints; however, the levels of ecological organization differ	Assessment endpoint is directly measured and, therefore, is equivalent to the measurement endpoint
2	**Correlation of stressor to response**	Endpoint response to stressor has not been demonstrated in previous studies but is expected based upon demonstrated response to similar stressors	In previous studies, endpoint response to stressor has been demonstrated, but response is not correlated with magnitude of exposure	Statistically significant correlation is demonstrated
3	**Utility of measure for judging environmental harm**	Measure is developed by the investigator (i.e., personal index) and has limited applicability and certainty, the scientific basis is weak, and the benchmark is relatively insensitive	Measure is well accepted and developed by a third party but has either limited applicability or certainty, or the scientific basis is weak, or the benchmark is relatively insensitive	Measure is well accepted and developed by a third party and has very high levels of certainty and applicability, as well as a very strong, scientific basis and benchmark is very sensitive
4	**Quality of data**	Three or more study objectives are not met, the level of error is large, and the data collected is not appropriate to address the assessment endpoint	One study objective is not met, the level of error is moderate, and the data collected is only moderately appropriate to address the assessment endpoint	All study objectives are met, the level of error is low to none, and the data collected appropriately addresses the assessment endpoint
5	**Site Specificity**	Only one or two of the six factors (i.e., data, media, species, environmental conditions, benchmark, habitat type) is derived from or reflects the site	Four of the six factors (i.e., data, media, species, environmental conditions, benchmark, habitat type) are derived from or reflect the site	All six factors (i.e., data, media, species, environmental conditions, benchmark, habitat type) are derived from or reflect the site (i.e., both data and benchmark reflect site conditions)
6	**Sensitivity of the measurement endpoint for detecting changes**	Measurement endpoint can detect only very large and obvious changes in response to stressor	Measurement endpoint can detect moderate level changes in response to stressor	Measurement endpoint is very sensitive and can detect very minute and subtle changes in response to stressor
7	**Spatial representativeness**	The locations of two of the following subjects overlap spatially only to limited extent: study area, sampling/measurement site, stressors, receptors, and points of potential exposure	The locations of three of the following subjects overlap spatially: study area, sampling/measurement site, stressors, receptors, and points of potential exposure	The locations of five of the following subjects overlap spatially: study area, sampling/measurement site, stressors, receptors, and points of potential exposure
8	**Temporal representativeness**	Measurements are collected during a season different from when effects would be expected to be most clearly manifested; AND A single sampling or measurement event is conducted; AND High variability in that parameter is expected over time	Measurements are collected during the same period that effects would be expected to be most clearly manifested; AND A single sampling or measurement event is conducted; AND Moderate variability in that parameter is expected over time	Measurements are collected during the same period that effects would be expected to be most clearly manifested; AND EITHER [two sampling events are conducted and variability is low OR multiple sampling events are conducted and variability is moderate to high]
9	**Quantitativeness**	Results are qualitative and are subject to individual interpretation	Results are quantitative, but data are insufficient to test for statistical significance	Results are quantitative and may be tested for statistical significance; such tests clearly reflect biological significance
10	**Use of a standard method**	Method has never been published AND methodology is not an impact assessment, field survey, toxicity test, benchmark approach, toxicity quotient, or tissue residue analysis	A standard method exists, but its suitability for this purpose is questionable, and it must be modified to be applicable to site specific conditions	A standard method exists and is directly applicable to the measurement endpoint and it was developed precisely for this purpose and requires no modification OR the methodology is used in three or more peer-reviewed studies

3.0 Results

3.1 RAPTORS

3.1.1 Information Review

In addition to the results of on-site field surveys, available information regarding the species composition, abundance, and migratory patterns of raptors in the vicinity of the Project area was reviewed. Sources of information included the results of regional bird surveys, information provided through agency consultations), telemetry data for eagles, and regional information on the distribution of raptors.

Hawk Migration Association of North America: HMANA is a membership-based organization that collects and maintains hawk watch data from nearly 200 affiliated raptor monitoring sites throughout the United States, Canada and Mexico. The HMANA database includes general site information, site coordinates, site contacts, season counts, daily counts, timing of counts, species observed, and directions to the site.

There are nine established HMANA hawk watch sites in New Hampshire, although only two of these sites have been used consistently over several years and receive more than a few hours of observation each season (HMANA 2007-2012). These two regularly-used sites are the Little Round Top Migration Observatory (Little Round Top) in Bristol, and the Pack Monadnock Raptor Migration Observatory (Pack Monadnock) in Peterborough. Little Round Top has been used as a survey location for eight years (2003 to 2009 and 2011). Pack Monadnock has been used as a survey location for nine years (2003 to 2011). Both have only been surveyed during the fall season. The Little Round Top site is located 15 miles east of the Project and is the closest HMANA site to the Project (Figure 3-1). Data obtained from this site from 2005 to 2009 are provided in Appendix B, Table 1. These results were also used to provide comparisons to surveys conducted at the Project site (Appendix B, Table 2).

Raptor Survey: Groton, Lempster, and Granite Reliable Wind Farms: In addition to the HMANA data, site specific raptor survey data is available from the proposed Groton Wind Farm (Groton) located in Groton, New Hampshire (Stantec 2009a), the Lempster Wind Farm located in Lempster, New Hampshire (LBG 2006), and the Granite Reliable Wind Farm located in Coos County, New Hampshire. Groton is located approximately 10 miles northeast of the Project, Lempster is located 70 miles southwest of the Project, and Granite Reliable is located approximately 130 miles northeast of the Project. For the Groton, Lempster, and Granite Reliable projects, the survey methods and objectives were based on HMANA methods (with the exception that flight heights were also documented). Surveys at Groton were conducted on 11 days from late March to late May, 2009, and on 10 days from late August to late October, 2009; surveys at Lempster were conducted on 10 days between late September and late October, 2005, and 10 days from late April through early May, 2006; surveys at Granite Reliable were conducted 10 days at 2 different sites in early April to early May in 2009 and 10 days at 2 different sites in late August to late October 2010. At all these NH projects, surveys targeted days with optimal migration weather, which typically included fair days with thermal development and winds generally from a northerly or southerly direction, depending on the season. Results from fall surveys conducted at Groton, Lempster, and Granite Reliable are compared to survey results at Little Round Top and Wild Meadows in Appendix B, Table 2.

(Note: Only fall seasons were included in Appendix B, Table 2 because there were no spring surveys conducted at Little Round Top.)

New Hampshire Breeding Bird Atlas: A BBA is a population survey tool intended to provide the distribution of breeding birds in a given region. The BBA is most often organized at either a state or provincial scale and this area is divided into a series of survey blocks or grid cells. Volunteers are assigned survey blocks where they conduct area searches. During area searches, volunteers record any breeding evidence for each bird species. Breeding evidence is described as one of three possible categories: confirmed, probable or possible. In New Hampshire, the BBA surveys were conducted between 1981 and 1986 and the results were summarized in the *Atlas of Breeding Birds in New Hampshire* (Foss 1994). For this survey, the state was divided into 1,000 survey blocks. Each block was one-sixth of a U. S. Geological Survey (USGS) 7.5 minute topographic quadrangle. Each block was approximately 9.3 square miles in size. One priority block from each quadrangle was randomly selected for survey. A total of 178 priority blocks were surveyed in addition to 14 selected special area blocks (BBA Explorer 2010; Foss 1994).

Two of the BBA priority blocks and one of the special survey areas occurred in proximity to the Project area (Foss 1994). These were priority block 8424 located principally in Grafton, priority block 8444 located in Danbury, and Mount Cardigan in Orange (Figure 3-1). Mount Cardigan was selected as a special survey area to capture one of the state's southern mountains that are less than 760 m (2,500') in elevation. Four years of surveys during the months of May to July were conducted in priority block 8424, and three years of surveys were conducted during these same months in priority block 8444. Although the methods of these surveys typically focus on breeding passerines, information on breeding raptors was obtained. Data obtained from these routes are provided in Appendix B, Table 3 and Table 4.

North American Breeding Bird Survey: The BBS was developed to provide a continent-wide perspective on avian population change. The program is cooperatively administered by the Patuxent Wildlife Research Center, which is part of the USGS, and the Canadian Wildlife Service's National Wildlife Research Center. The BBS was initially launched in 1966 and continues today. Surveys are conducted annually by skilled volunteers. Surveys are timed to occur during the peak of the nesting season, primarily in June, and occur along established routes. Each route is 24.5 miles long with a total of 50 individual survey points located at 0.5 mile intervals along the route. At each survey point, a three-minute point count is conducted and every bird seen or heard within a 0.25-mile radius is recorded. There are over 4,100 BBS routes across the continental United States and Canada and 25 of these routes are located in New Hampshire.

The BBS route closest to the Project area is route number 58011, also referred to as the Wilmot route (Sauer *et al.* 2011; Figure 3-1). This route begins in the town of Wilmot in Merrimack County and runs north and northwest ending in Alexandria in Grafton County. In Grafton, the route passes between Melvin Mountain and Tinkham Mountain, two of the Project area ridgelines. The land cover data indicates that the route is primarily forested with other cover types including woody wetlands, open water, agricultural lands, and low density residential development. Although the methods of these surveys typically focus on breeding passerines, information on breeding raptors was obtained. Data obtained from this route from 1966 to 2007 are provided in Appendix B, Table 5.

The National Audubon Society Christmas Bird Count: The CBC was developed to monitor the status and distribution of birds in the Western Hemisphere. The CBC is performed annually in locations throughout North, Central and South America, including island nations, from December 14 to January 5. Volunteer birders record all birds seen or heard within their designated “count circle”. An individual count circle is 15 miles in diameter as measured from an established central point and this area remains the same from year to year. Each year approximately 10 observers survey an individual count circle over a period of 24 hours. The National Audubon Society maintains a database that summarizes the results of the various count locations and coordinates the count circles so that they do not overlap.

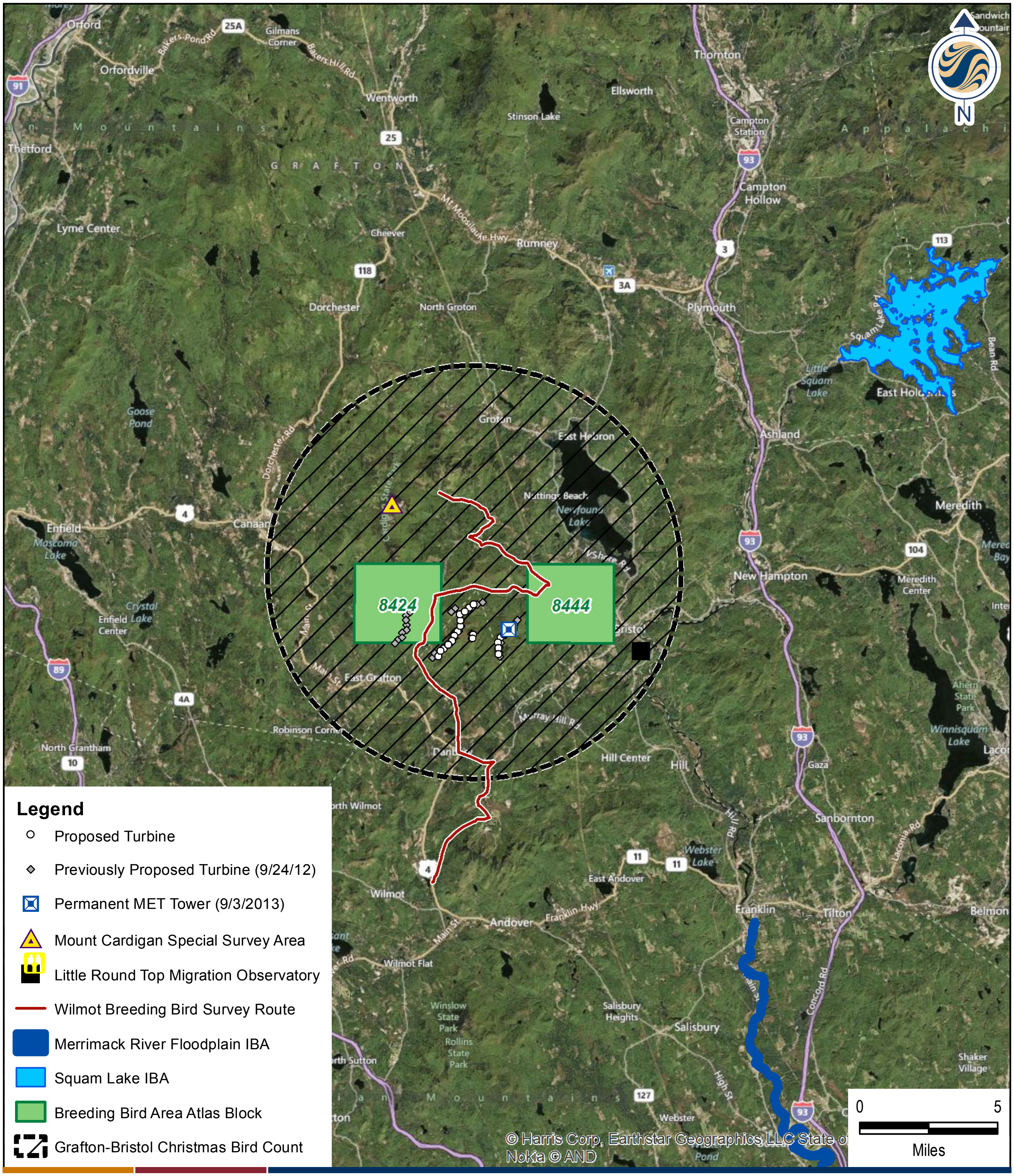
In New Hampshire there are 21 established count circles. The Grafton-Bristol New Hampshire (NHGB) count circle 20 overlaps with the Project area (Figure 3-1). Data for the NHGB count circle are available from the past five “count years” (2004-2005 through 2008-2009) and are provided in Appendix B, Table 6.

The National Audubon Society Important Bird Area Program: The Important Bird Area (IBA) program is an international effort to identify and conserve areas that are important to one or more bird species for some part of their life cycle (i.e., breeding, feeding, wintering or migration). In New Hampshire the IBA program is maintained by NH Audubon working with the NHFGD, the New Hampshire Partners in Flight Committee (NH PIF), and the University of New Hampshire Cooperative Extension. Any area that meets one or more of three principal criteria can be nominated and, following review, accepted as an IBA.

The three principle IBA criteria and one supplemental criterion are:

1. Areas that consistently support significant numbers of federally- or state-listed endangered or threatened species;
2. Areas that consistently support an assemblage of bird species that are characteristic of rare, threatened, or unique habitat types within the state. This includes areas supporting significant numbers of bird species identified as high conservation priority in New Hampshire based upon state and regional conservation plans;
3. Areas where birds congregate in significant numbers during the breeding season, winter, or migration; and
4. Areas important for long-term bird research or monitoring projects that contributes substantially to ornithology and/or bird conservation. A site cannot be designated as an IBA under this criterion alone, but it is considered in conjunction with the other above listed criteria.

The Project area does not fall within any of the 17 designated IBAs in New Hampshire (NH Audubon 2009). The nearest IBAs are Squam Lake located approximately 15 miles to the northeast of the Project area and the Merrimack River Floodplain located approximately 15 miles to the southeast (Figure 3-1).



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Client/Project

Atlantic Wind LLC
Wild Meadows Project
Merrimack & Grafton Counties, New Hampshire

Figure No.

3-1

Title

Regional Bird Survey Location Map

November 15, 2012
REV: 10/30/13

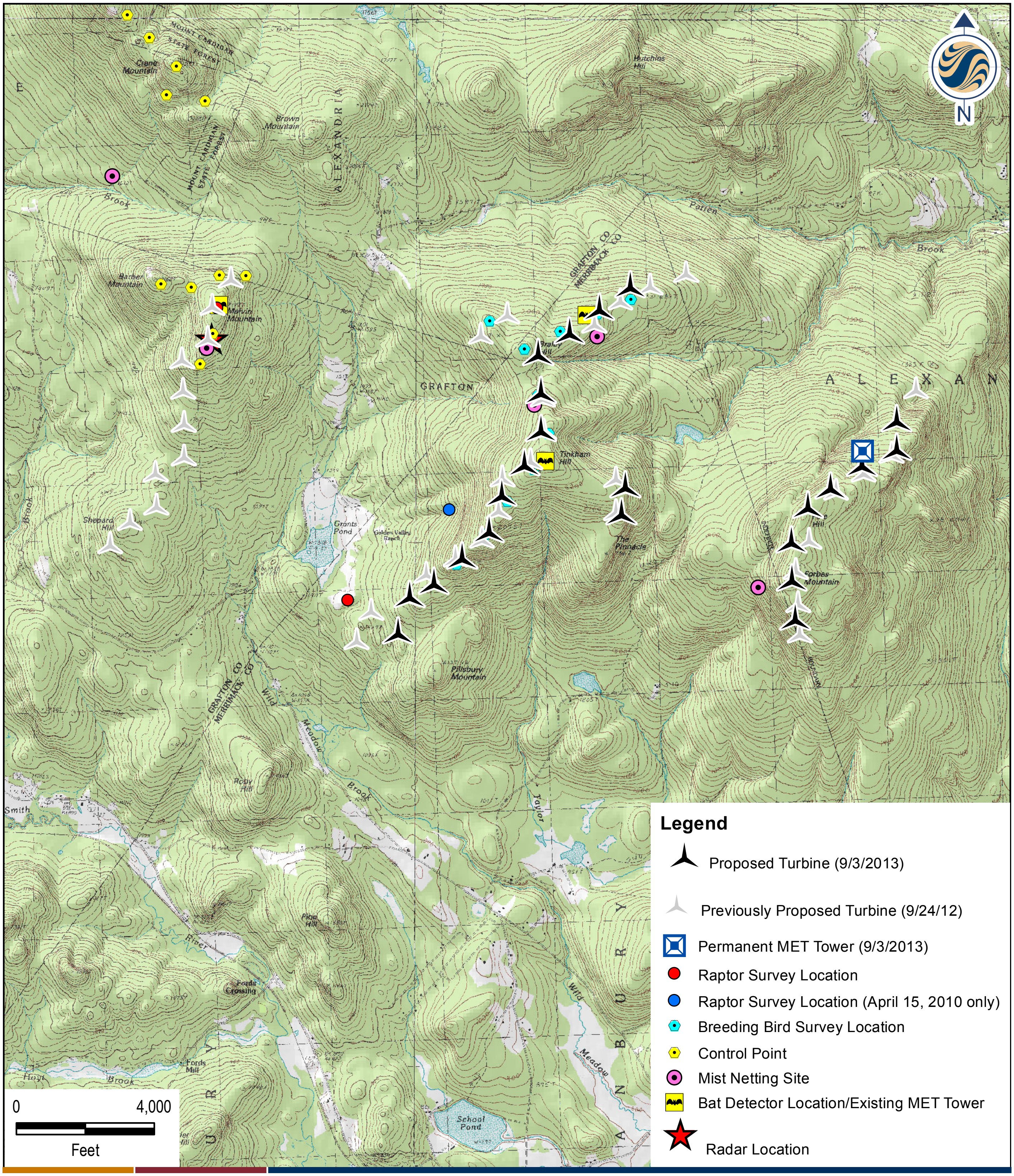
Priority Species Lists: The NH Nongame and Endangered Wildlife Program (NH NEWP) maintains an inventory of species in the state that are considered rare, threatened, endangered, or species of special concern in the state[1]. The NH PIF maintains an inventory of species that are considered rare or priority species in the state[2]. The USFWS Migratory Bird Program maintains an inventory of Birds of Conservation Concern to comply with the 1988 amendment to the Fish and Wildlife Conservation Act. This act mandates the USFWS to "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act (ESA) of 1973"[3]. These inventories combine to create a list of RTE species found in the state of New Hampshire. RTE species that occurred either in the Project area during on-site field surveys, or were detected in the region during HMANA, BBS or Audubon CBC surveys; and are on the NHFGD, NH PIF, or USFWS BCC lists, are included in Appendix B, Table 7 and Table 8.

Post-Construction Mortality Results: Also available were the results of 45 post-construction mortality studies conducted at 31 different locations throughout the eastern U.S. These studies provided information regarding the numbers of individuals and species of raptors that have been involved with collisions at wind farms (Appendix B, Table 9).

3.1.2 Field Surveys

On-site field surveys to document raptor activity in the Project area were conducted during one spring migration season and one fall migration season (Table 2-1). During each seasonal survey, observational data were collected simultaneously by one Stantec biologist and one NH Audubon biologist from two separate observation points either in, or in proximity to, the current Project area (Figure 3-2). Survey methods were based on standard methodologies used for raptor migration surveys at wind development sites in the region. Detailed descriptions of the methods and results of these surveys are included in the field report (Stantec 2011c).

[1] http://www.wildlife.state.nh.us/Wildlife/Nongame/endangered_list.htm
[2] http://www.anselm.edu/homepage/jpitocch/NHPIF2.html
[3] http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/BirdManagement.html



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Client/Project

Atlantic Wind LLC
Wild Meadows Project
Merrimack & Grafton Counties, New Hampshire

Figure No.

3-2

Title

Pre-Construction Survey Location Map

November 15, 2012
REV: 10/30/13

3.1.3 Risk Assessment Endpoints

Two assessment endpoints were chosen for the evaluation of risk to raptors associated with the Project: (1) potential collision mortality of raptors, including resident and migrating individuals, and (2) potential habitat loss or displacement of raptors from the Project area. Four measurement endpoints were identified for these assessment endpoints as specified in Table 3-1. Measurement endpoints consisted of literature review (1a and 2a), results of spring and fall raptor field surveys (1b), and results of a general habitat characterization (2b). Literature review included a review of information on interactions between raptors and wind turbines, collision mortality data from operational wind projects, and information on the distribution of raptors (including RTE species) in the vicinity of the Project area.

Table 3-1. Assessment and measurement endpoints used to assess risk to raptors at the Wild Meadows Wind Project.

Assessment Endpoint		Measurement Endpoints		Measurement Endpoint Response
1	Potential collision mortality of resident and migratory raptors	1a	Literature Review	Review literature regarding interactions between raptors and turbines and collision mortality results from other sites. Document species composition, abundance, and flight patterns of raptors in the Project area and surrounding area.
		1b	Raptor Migration Surveys and Regional Bird Surveys	
2	Potential habitat loss or displacement of raptors from the Project area	2a	Literature Review	Characterize available habitat pre-construction, and the types of habitat loss/conversion resulting from construction.
		2b	General Habitat Characterization	

Each measurement/assessment endpoint pair was assigned a weight based on the attributes and criteria described in the methods section. Overall, the measurement endpoints were evaluated as medium to low weight-of-evidence (Table 3-2). However, the relatively low scoring of measurement endpoints used in the risk assessment is not a result of insufficient pre-construction data, which provided a thorough characterization of migration activity of raptors through the Project area. Instead, the uncertainty stems from the lack of understanding of the connection between pre-construction surveys and rates of mortality once facilities become operational. Moreover, the stressor is not yet present in the landscape. It is important to note that additional pre-construction surveys would not necessarily increase the rankings of these attributes or the ability to accurately predict risk to raptors, because there appears to be no relationship between the results of baseline raptor migration surveys and the number of raptors found during post-construction fatality surveys.

To date, wind power facilities in New England have documented low mortality rates during post-construction surveys making correlations between pre- and post-construction surveys difficult. However, the operational Lempster and Groton Wind Projects are relatively proximal and are generally similar in elevation and habitat to the Wild Meadows Wind Project. These operational projects in New Hampshire may provide useful insight as to potential impacts to raptors from the Wild Meadows Project by comparing the pre-construction data among projects.

Table 3-2. Weight-of-evidence evaluation of measurement endpoints used to evaluate risk to raptors at the Wild Meadows Wind Project.

Attributes	Measurement Endpoints				Rationale
	Collision mortality		Indirect Impacts		
	1a Literature Review	1b Raptor Migration Surveys and Regional Bird Surveys	2a Literature Review	2b Habitat Characterization	
II. Strength of Association between Assessment and Measurement Endpoint					
Degree of Biological Association	Medium	Medium	Medium	Medium	Literature review can directly characterize patterns in collision mortality and indirect displacement at existing wind farms only. Pre-construction raptor surveys can document species composition and behavior of raptors, although these results can only be used indirectly to characterize risk of collision or indirect impacts, as relationships between pre-construction surveys and post-construction surveys have not been established.
Stressor/Response	Medium	Medium	Medium	Medium	Increased exposure to wind turbines presumably increases risk of collision, although the mechanisms explaining collision mortality remain ambiguous. However, patterns in collision mortality, raptor avoidance capabilities, and indirect impacts will likely be similar between sites, so as more information is gathered, this relationship will become stronger, for at least some species.
Utility of Measure	Medium	Medium	Medium	Medium	The methods used for raptor migration surveys and habitat surveys (and the literature that reports their results) are well accepted and developed by a third party, but they have limited applicability and are relatively insensitive for determining risk.
II. Data Quality					
Data Quality	Medium	Medium	Medium	Medium	Raptor surveys are an appropriate tool to characterize the population of raptors in the Project area. Although surveys were conducted in a rigorous manner, results of these types of ecological surveys are inherently subject to uncertainty and require extrapolation to relate to the assessment endpoints.
III. Study Design					
Site Specificity	Low	High	Low	High	Raptor migration and habitat surveys provide highly site-specific data that could provide means for comparison of pre- and post-construction results. Literature review of mortality surveys at other sites has uncertain applicability to the exposure site. Habitat characterizations directly measure loss/conversion at the site of interest and lit review of habitat loss at other areas is probably moderately applicable.
Sensitivity	Low	High	Low	Medium	Raptor surveys can detect subtle changes in the species composition, relative abundance, and behavior of raptors in the Project area provided that surveys are conducted on a regular basis using the same methods. Habitat characterizations can detect moderate level changes in raptor habitat from measuring loss/conversion.
Spatial Representativeness	Low	High	Low	Medium	Raptor surveys were conducted from two sites that were either within or proximal to the Project area. Habitat characterizations were general, focusing on dominant conditions and major losses/conversions expected.
Temporal Representativeness	N/A	High	N/A	Medium	Raptor surveys took place during the active spring and fall migration periods, and occurred throughout most of the migration period.
Quantitative Measure	Low	Low	Medium	Low	The magnitude of response to the stressor cannot be tested statistically for pre-construction raptor surveys, because the exposure has not yet occurred. Statistical tests, such as those used in spatial statistics in GIS analysis of fragmentation or connectivity, could be conducted and applied to a predictive model of impact to raptor habitat.
Standard Method	N/A	Medium	N/A	Medium	A standard method exists for conducting raptor migration surveys, but its applicability to predicting risk is questionable. Methods for habitat characterizations are well documented and application to evaluating loss/conversion of bat habitat could be standardized.
Overall Endpoint Value*	Low/Medium	Medium/High	Low/Medium	Medium	

* Overall endpoint value was determined by determining the number of attributes ranked as "low", "medium", and "high" for each measurement endpoint.

3.2 NOCTURNALLY MIGRATING PASSERINES

3.2.1 Information Review

Nocturnal migrants consist primarily of migrating passerines. Although various species of migratory bats also migrate at night, potential impacts to migratory bats are discussed separately in sections 3.4 and 4.4. Little information is available on regional patterns, numbers, and species composition of nocturnally migrating passerines. However, general literature exists on behavior of migrating birds with respect to topography, seasonal timing, and general migration routes. Also, an increasing amount of information from radar surveys conducted at proposed wind projects is becoming publicly available and provides general information on flight heights and passage rates on a somewhat more specific level. Several entities have conducted numerous radar surveys at proposed wind projects throughout the east between 2004 and 2009 (Appendix A, Table 5 in the Fall 2009 Radar Survey Report [Stantec 2011a] and Appendix A, Table 5 in the Spring 2010 Avian and Bat Survey Report [Stantec 2011b]). Results of these surveys were compared to those from the Project area to provide context, and to characterize overall anticipated migration patterns in the vicinity of the Project.

Also available were the results of 45 post-construction mortality studies conducted at 31 different locations throughout the eastern U.S. These studies provide information regarding the numbers of individuals and species of nocturnally migrating passerines that have been involved with collisions at wind farms (Appendix B, Table 10).

3.2.2 Field Surveys

Nocturnal marine radar surveys were conducted in proximity to the Project area during fall 2009 and spring 2010 from a meteorological tower clearing near the summit of Melvin Mountain (previously considered within the Project area) (Table 2-1, Figure 3-2). This location provided good views in most directions, including to the east where topography dropped abruptly to the adjacent valley. Although the radar's view was partially obscured in some areas of the radar detection range, targets could be tracked as they moved in and out of those areas, and views into the adjacent valley allowed for the detection of targets below the horizon in this direction.

During the fall survey, 35 nights were surveyed between August 20 and October 15, 2009. During the spring survey, 33 nights were surveyed between April 15 and May 26, 2010. An X-band, 12 kilowatt (kW) marine radar unit mounted on a fixed platform 7 m (25') above ground level was used in the same location for both surveys, which were conducted using the same methodology. Detailed summaries of survey methods and results are included in the seasonal radar survey reports (Stantec 2011a, Stantec 2011b). Mean hourly and nightly passage rates, flight direction, and flight heights were determined for the duration of each survey. In addition to radar surveys, general notes on suitability of habitat within the Project area as stopover habitat for migrating passerines, as well as incidental observations of migratory flocks were taken during on-site field surveys.

3.2.3 Risk Assessment

A single assessment endpoint was chosen for the evaluation of risk to nocturnally migrating passerines associated with the Project: potential collision mortality of nocturnally migrating passerines. Potential indirect impacts to nocturnally migrating passerines, such as loss of stopover habitat, are discussed under indirect impacts to breeding birds. Because sufficient data do not exist to characterize patterns of nocturnal migration within the Project area on a species-specific or even guild-specific level, risk is discussed for nocturnal migrants as a group. Measurement endpoints were identified for each assessment endpoint as specified in Table 3-3. Measurement endpoints consisted of literature review (3a) and results of spring and fall nocturnal radar surveys (3b). Literature review included a review of information on interactions between nocturnally migrating passerines and wind turbines, collision mortality data from operational wind projects including the Lempster Wind Project in Lempster, the Granite Reliable Project in Coos County, and the Groton Wind Project in Grafton, New Hampshire, and information on general migration patterns in the vicinity of the Project area.

Table 3-3. Assessment and measurement endpoints used to assess risk to nocturnally migrating passerines at the Wild Meadows Wind Project.

Assessment Endpoint		Measurement Endpoints		Measurement Endpoint Response
3	Potential collision mortality of nocturnally migrating passerines	3a	Literature Review	Review literature regarding interactions between nocturnal migrants and turbines and collision mortality results from other sites. Document flight patterns of nocturnal migrants in the vicinity of the Project area during spring and fall migration periods.
		3b	On-site Radar Surveys	

Each measurement/assessment endpoint pair was assigned a weight based on the attributes and criteria described in the methods section. Overall, the measurement endpoints were evaluated as medium to low weight-of-evidence (Table 3-4). However, the relatively low scoring of measurement endpoints used in the risk assessment is not a result of insufficient pre-construction data, which provided a thorough characterization of nocturnal migration activity in the Project area. Instead, the uncertainty stems from the lack of understanding of the connection between pre-construction surveys and rates of mortality once facilities become operational. Moreover, the stressor is not yet present in the landscape. It is important to note that additional pre-construction surveys would not necessarily increase the rankings of these attributes or the ability to accurately predict risk to nocturnally migrating passerines, specifically because additional field survey data would not further detail the link between pre-construction and post-construction conditions until the Project is constructed.

Based on post-construction surveys in New England, pre-construction passage rates and post-construction mortality have a tenuous relationship. Relatively low numbers of nocturnal migrant fatalities reported at post-construction sites in New England make correlation with pre-construction rates difficult. Thus, higher pre-construction passage rates do not equate to higher risk of mortality and vice versa. In the case of the Lempster Wind Project, pre-construction passage rates were near the higher end of the range of other studies conducted in the northeast during the fall season, and post construction mortality surveys documented very low bird mortality. Nevertheless, nearby operational facilities such as the Lempster Wind Project, which is similar in elevation and habitat to the Wild Meadows Wind Project, may provide useful insight as to potential impacts to nocturnally migrating passerines from the Wild Meadows Project by comparing the pre-construction data between the two sites. At the very least these types of pre-construction comparisons allow for the identification of sites that may be an anomaly which may lead to a greater risk of impact.

Table 3-4. Weight-of-evidence evaluation of measurement endpoints used to evaluate risk to nocturnal migrants at the Wild Meadows Wind Project.

Attributes	Measurement Endpoints Collision mortality 3a Literature Review	 3b Spring and Fall Radar Surveys	Rationale
II. Strength of Association between Assessment and Measurement Endpoint			
Degree of Biological Association	Medium	Medium	Pre-construction radar surveys can document flight patterns and passage rates of nocturnal migrants in the vicinity of the Project area, although these results can only be used indirectly to characterize risk of collision or indirect impacts, as relationships between pre-construction surveys and post-construction surveys have not been established. Literature review can directly characterize patterns in collision mortality and indirect displacement at existing wind farms only.
Stressor/Response	Medium	Medium	Increased exposure to wind turbines presumably increases risk of collision, although the mechanisms explaining collision mortality remain ambiguous. However, patterns in collision mortality, avoidance behavior, and indirect impacts will likely be similar between sites, so as more information is gathered, this relationship is expected to become stronger.
Utility of Measure	Medium	Medium	The methods used for radar surveys and habitat characterizations (and the literature that reports their results) are well accepted and developed by a third party, but they have limited applicability and are relatively insensitive for determining risk.
II. Data Quality			
Data Quality	High	High	Radar surveys provide an appropriate means to characterize migration patterns of nocturnal migrants in the vicinity of the Project area, and surveys were conducted in a rigorous manner. However, results of these types of ecological surveys are inherently subject to uncertainty and require extrapolation to relate to the assessment endpoints.
III. Study Design			
Site Specificity	Low	High	Radar and habitat characterizations provide highly site-specific data that could provide means for comparison of pre- and post-construction results. Literature review of mortality surveys at other sites has uncertain applicability to the exposure site. Habitat characterizations directly measure loss/conversion at the site of interest and literature review of habitat loss at other areas is probably moderately applicable.
Sensitivity	Low	High	Radar surveys can detect relatively subtle changes in the flight patterns and passage rates of nocturnal migrants, which could be used to assess effects of wind turbines on migration provided that pre- and post-construction surveys were conducted in a suitable manner.
Spatial Representativeness	Low	Medium	Although radar surveys were conducted from only one site in the vicinity of the Project area, a general understanding of patterns in migration of nocturnal migrants suggests that patterns would be relatively uniform throughout the Project area. Habitat characterizations were general, focusing on dominant conditions and major losses/conversions expected.
Temporal Representativeness	N/A	High	Radar surveys took place during a representative sample of the spring and fall migration periods, accurately characterizing the range of migration activity.
Quantitative Measure	Low	Low	The magnitude of response to the stressor cannot be tested statistically for pre-construction radar surveys, because the exposure has not yet occurred. Statistical tests, such as those used in spatial statistics in GIS analysis of fragmentation or connectivity, could be conducted and applied to a predictive model of impact to habitat for nocturnal migrants.
Standard Method	N/A	Medium	A standard method exists for conducting radar migration surveys, but its applicability to predicting risk is questionable. Methods for habitat characterizations are well documented and application to evaluating loss/conversion of bat habitat could be standardized.
Overall Endpoint Value*	Low/Medium	Medium	

* Overall endpoint value was determined by determining the number of attributes ranked as “low”, “medium”, and “high” for each measurement endpoint.

3.3 BREEDING BIRDS

3.3.1 Information Review

In addition to the results of on-site field surveys, available information regarding the species composition, abundance, and migratory patterns of breeding birds in the vicinity of the Project area was reviewed. Sources of information included the results of regional bird surveys, information provided through agency consultations, and regional information on breeding bird distribution.

New Hampshire Breeding Bird Atlas: A BBA is a population survey tool intended to provide the distribution of breeding birds in a given region. The BBA is most often organized at either a state or provincial scale and this area is divided into a series of survey blocks or grid cells. Volunteers are assigned survey blocks where they conduct area searches. During area searches, volunteers record any breeding evidence for each bird species. Breeding evidence is described as one of three possible categories: confirmed, probable or possible. In New Hampshire, the BBA surveys were conducted between 1981 and 1986 and the results were summarized in the *Atlas of Breeding Birds in New Hampshire* (Foss 1994). For this survey, the state was divided into 1,000 survey blocks. Each block was one-sixth of a USGS 7.5 minute topographic quadrangle. Each block was approximately 9.3 square miles in size. One priority block from each quadrangle was randomly selected for survey. A total of 178 priority blocks were surveyed in addition to 14 selected special area blocks (BBA Explorer 2010; Foss 1994).

Two of the BBA priority blocks and one of the special survey areas occurred in proximity to the Project area (Foss 1994). These were priority block 8424 located principally in Grafton, priority block 8444 located in Danbury, and Mount Cardigan in Orange (Figure 3-1). Mount Cardigan was selected as a special survey area to capture one of the state's southern mountains that are less than 760 m (2,500') in elevation. Four years of surveys during the months of May to July were conducted in priority block 8424, and three years of surveys were conducted during these same months in priority block 8444. Data obtained from these routes are provided in Appendix B, Table 3 and Table 4.

North American Breeding Bird Survey: The BBS was developed to provide a continent-wide perspective on avian population change. The program is cooperatively administered by the Patuxent Wildlife Research Center, which is part of the USGS, and the Canadian Wildlife Service's National Wildlife Research Center. The BBS was initially launched in 1966 and continues today. Surveys are conducted annually by skilled volunteers. Surveys are timed to occur during the peak of the nesting season, primarily in June, and occur along established routes. Each route is 24.5 miles long with a total of 50 individual survey points located at 0.5 mile intervals along the route. At each survey point, a three-minute point count is conducted and every bird seen or heard within a 0.25-mile radius is recorded. There are over 4,100 BBS routes across the continental United States and Canada and 25 of these routes are located in New Hampshire.

The BBS route closest to the Project area is route number 58011 also referred to as the Wilmot route (Sauer *et al.* 2011) (Figure 3-1). This route begins in the town of Wilmot in Merrimack County and runs north and northwest ending in Alexandria in Grafton County. In Grafton, the route passes between Melvin Mountain and Tinkham Mountain. The land cover data indicates that the route is primarily forested with other cover types including woody wetlands, open water, agricultural lands, and low density residential development. Data obtained from this route from 1966 to 2007 are provided in Appendix B, Table 5.

The National Audubon Society Christmas Bird Count: The CBC was developed to monitor the status and distribution of birds in the Western Hemisphere. The CBC is performed annually in locations throughout North, Central and South America, including island nations, from December 14 to January 5. Volunteer birders record all birds seen or heard within their designated “count circle”. An individual count circle is 15 miles in diameter as measured from an established central point and this area remains the same from year to year. Each year approximately 10 observers survey an individual count circle over a period of 24 hours. The National Audubon Society maintains a database that summarizes the results of the various count locations and coordinates the count circles so that they do not overlap.

In New Hampshire there are 21 established count circles. The NHGB count circle 20 overlaps with the Project area (Figure 3-1). Data for the NHGB count circle are available from the past five “count years” (2004-2005 through 2008-2009) and are provided in Appendix B, Table 6.

The National Audubon Society Important Bird Area Program: The IBA program is an international effort to identify and conserve areas that are important to one or more bird species for some part of their life cycle (i.e., breeding, feeding, wintering or migration). In New Hampshire the IBA program is maintained by NH Audubon working with the NHFGD, the NH PIF, and the University of New Hampshire Cooperative Extension. Any area that meets one or more of three principal criteria can be nominated and, following review, accepted as an IBA.

The three principle IBA criteria and one supplemental criterion are:

1. Areas that consistently support significant numbers of federally- or state-listed endangered or threatened species;
2. Areas that consistently support an assemblage of bird species that are characteristic of rare, threatened, or unique habitat types within the state. This includes areas supporting significant numbers of bird species identified as high conservation priority in New Hampshire based upon state and regional conservation plans;
3. Areas where birds congregate in significant numbers during the breeding season, winter, or migration; and
4. Areas important for long-term bird research or monitoring projects that contribute substantially to ornithology and/or bird conservation. A site cannot be designated as an IBA under this criterion alone, but it is considered in conjunction with the other above listed criteria.

The Project area does not fall within any of the 17 designated IBAs in New Hampshire (NH Audubon 2009). The nearest IBAs are Squam Lake located approximately 15 miles to the northeast of the Project area and the Merrimack River Floodplain located approximately 15 miles to the southeast (Figure 3-1).

eBird: The Cornell Bird Laboratory and the National Audubon Society developed an online checklist tool known as eBird to store avian abundance and distribution data collected by amateur and professional bird watchers across the country[4]. Data submissions are available in real-time as they are submitted and can be accessed in many different forms by species, region,

[4] http://ebird.org/content/ebird/about

high counts, arrival/departure dates and more. For the purposes of comparison, 2010 data from Merrimack and Grafton Counties were downloaded for the dates Jan 1 – Dec 31. Whereas CBC, BBS, and BBA surveys are season-specific, the data submitted to eBird is annual and often includes migrant or incidental species that may be seasonally abundant but not documented from other survey types.

Priority Species Lists: The NH NEWP maintains an inventory of species in the state that are considered rare, threatened, endangered, or species of special concern in the state[5]. The NH PIF maintains an inventory of species that are considered rare or priority species in the state[6]. The USFWS Migratory Bird Program maintains an inventory of Birds of Conservation Concern to comply with the 1988 amendment to the Fish and Wildlife Conservation Act. This act mandates the USFWS to "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the ESA of 1973"[7]. These inventories combine to create a list of rare, threatened, or endangered (RTE) species found in the state of New Hampshire. RTE species that occurred either in the Project area during on-site field surveys, or were detected in the region during the BBS or Audubon CBC surveys, and are on the NH NEWP, NH PIF, or USFWS BCC lists, are included in Appendix B, Table 7 and Table 8.

Birds of North America Online: For certain species within the Project area, natural history information was obtained to help assess potential levels of direct and indirect risk associated with the Project. These data were obtained from a variety of sources, including literature reported in the Birds of North America (BNA) Online (2009) and other species-specific literature, and are included in relevant sections of the discussion. The above sources of data were used, in combination with results of field surveys, to characterize the overall breeding bird population within the Project area and immediate vicinity.

Post-Construction Mortality Results: Also available were the results of 45 post-construction mortality studies conducted at 31 different locations throughout the eastern U.S. These studies provide information regarding the numbers of individuals and species of birds that have been involved with collisions at wind farms (Appendix B, Table 10).

3.3.2 Field Surveys

Field surveys for breeding birds within the Project area consisted of two rounds of BBS point counts according to a modified USGS survey protocol (Table 2-1). These surveys consisted of 10-minute point counts distributed throughout the Project and in the surrounding area, including 21 locations in proximity to the proposed turbines and 6 control points outside of the area of proposed impact (Figure 3-2). Each survey location was sampled during two survey periods, one in mid-June (June 2 and 3) and one in late June (June 15 and 16). On-site BBS also included documentation of incidental observations made outside of the official point count periods but during on-site visits. A detailed summary of the methods and results of these surveys can be found in the Spring 2010 Avian and Bat Survey Report (Stantec 2011b), along with the complete list of species detected in the Project and surrounding area during the BBS (Appendix C, Tables 1 through 5 [Stantec 2011b]). In addition to on-site BBS, habitat

[5] http://www.wildlife.state.nh.us/Wildlife/Nongame/endangered_list.htm
[6] http://www.anselm.edu/homepage/jpitocch/NHPIF2.html
[7] http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/BirdManagement.html

characterizations, consisting of qualitative notes made during on-site field surveys, also contributed to the risk assessment.

3.3.3 Risk Assessment Endpoints

Two assessment endpoints were chosen for the evaluation of risk to breeding birds associated with the Project: potential collision mortality of breeding birds (assessment endpoint 4), and; potential indirect impacts (habitat loss, displacement) to breeding birds (assessment endpoint 5). When possible, potential impacts to individual species or guilds are discussed for each assessment endpoint. Measurement endpoints were identified for each assessment endpoint as specified in Table 3-5. Measurement endpoints consisted of results of literature review (4a and 5a), on-site and regional breeding bird surveys (4b), and habitat characterizations (5b). Literature review included a review of information on interactions between breeding birds and wind turbines, collision mortality data from operational wind projects, and information regarding potential effects of habitat loss and conversion on breeding birds.

Table 3-5. Assessment and measurement endpoints used to assess risk to breeding birds at the Wild Meadows Wind Project.

Assessment Endpoint		**Measurement Endpoints**		**Measurement Endpoint Response**
4	Potential collision mortality of breeding birds	4a	Literature Review	Review literature regarding interactions between breeding birds and turbines and collision mortality results from other sites. Document species diversity, relative abundance, and distribution of breeding birds in the Project and the surrounding area.
		4b	On-site and Regional Bird Surveys	
5	Potential indirect impacts to breeding birds	5a	Literature Review	Determine how habitat loss/conversion may impact breeding bird abundance and distribution in the Project and the surrounding area.
		5b	Habitat Characterization	

Each measurement/assessment endpoint pair was assigned a weight based on the attributes and criteria described in the methods section. Overall, the measurement endpoints were evaluated as medium to low weight-of-evidence (Table 3-6). However, the relatively low scoring of measurement endpoints used in the risk assessment is not a result of insufficient pre-construction data, which provided a thorough characterization of the population of breeding birds in the Project area. Instead, the uncertainty stems from the lack of understanding of the connection between pre-construction surveys and rates of mortality or displacement behavior once facilities become operational. Moreover, the stressor is not yet present in the landscape. It is important to note that additional pre-construction surveys would not necessarily increase the rankings of these attributes or the ability to accurately predict risk to breeding birds, specifically because additional field survey data would not further the understanding of the link between pre-construction and post-construction conditions until the Project is constructed. However, one season of breeding bird surveys provide the opportunity to determine if RTE species or their habitats are present at the Project and surrounding area and provide a baseline data set for assessing potential post construction changes in the breeding bird community. This data is also useful for comparing pre-construction survey data from similar projects and habitats that have been developed and also conducted post construction mortality studies to get a better perspective of potential impacts to breeding birds.

Table 3-6. Weight-of-evidence evaluation of measurement endpoints used to evaluate risk to breeding birds at the Wild Meadows Wind Project.

Attributes	Measurement Endpoints				Rationale
	Collision Mortality		Indirect Impacts		
	4a Literature Review	4b On-site and Regional Bird Surveys	5a Literature Review	5b Habitat Characterization	
I. Strength of Association between Assessment and Measurement Endpoint					
Degree of Biological Association	Medium	Medium	Medium	Medium	Literature review can directly characterize patterns in collision mortality and indirect displacement at existing wind farms only. Pre-construction breeding bird surveys can document species composition and relative abundance of breeding birds in the Project and surrounding area, although these results can only be used indirectly to characterize potential risk of collision or indirect impacts, as relationships between pre-construction surveys and post-construction surveys have not been established.
Stressor/Response	Medium	Medium	Medium	Medium	Increased exposure to wind turbines presumably increases risk of collision, although the mechanisms explaining collision mortality remain ambiguous. However, patterns in collision mortality and indirect impacts will likely be similar between sites, so as more information is gathered, this relationship is expected to become stronger.
Utility of Measure	Medium	Medium	Medium	Medium	The methods used for breeding bird surveys and habitat characterizations (and the literature that reports their results) are well accepted and developed by a third party, but have limited applicability and are relatively insensitive for determining risk.
II. Data Quality					
Data Quality	High	High	High	High	Breeding bird surveys provide an appropriate means to characterize the breeding bird population in the Project and surrounding area, and surveys were conducted in a rigorous manner. However, results of these types of ecological surveys are inherently subject to uncertainty and require extrapolation to relate to the assessment endpoints.
III. Study Design					
Site Specificity	Low	High	Medium	High	Literature review of mortality surveys at other sites has uncertain applicability to the exposure site. Breeding bird and habitat characterizations provide highly site-specific data that could provide means for comparison of pre- and post-construction results. Habitat characterizations directly measure loss/conversion at the site of interest and literature review of habitat loss at other areas is probably moderately applicable.
Sensitivity	Low	High	Low	Medium	Breeding bird surveys can detect changes in species composition and abundance of breeding birds over time, which could be used to assess indirect impacts of the wind Project provided that pre- and post-construction surveys were conducted in a suitable manner. Habitat assessments can detect moderate level changes in breeding bird habitat from measuring loss/conversion.
Spatial Representativeness	Low	High	Low	Medium	Breeding bird surveys were conducted in the Project and surrounding area in a variety of representative habitats. Habitat characterizations were general, focusing on dominant conditions and major losses/conversions expected.
Temporal Representativeness	N/A	High	N/A	N/A	On-site field surveys took place at two time periods during the active breeding season of birds. Regional surveys include data from one survey year.
Quantitative Measure	Low	Low	Medium	Low	The magnitude of response to the stressor cannot be tested statistically for pre-construction breeding bird surveys, because the exposure has not yet occurred. Statistical tests, such as those used in spatial statistics in GIS analysis of fragmentation or connectivity, could be conducted and applied to a predictive model of impact to habitat for nocturnal migrants.
Standard Method	N/A	Medium	N/A	Medium	A standard method exists for conducting breeding bird surveys, but its applicability to predicting risk is questionable. Methods for habitat characterizations are well documented and application to evaluating loss/conversion of bat habitat could be standardized.
Overall Endpoint Value*	Low/Medium	Medium/High	Low/Medium	Medium	

* Overall endpoint value was determined by determining the number of attributes ranked as “low”, “medium”, and “high” for each measurement endpoint.

3.4 BATS

3.4.1 Information Review

Sources of information relating to the abundance and distribution of bats in the northeast, and particularly in New Hampshire, are limited. Stantec reviewed literature on the overall distribution of species in the east, with the understanding that these types of data are rarely specific enough to draw conclusions on a site-specific basis. Qualitative habitat information gathered during field surveys at in the Project area, such as landscape cover, forest structure, distribution and type of wetlands, presence of caves, and topography was used to characterize the overall suitability of the Project area for bats.

3.4.2 Field Surveys

On-site field surveys for bats consisted of acoustic monitoring and a mist net survey (Table 2-1). In 2009, 3 acoustic bat detectors were deployed during the fall season. In 2010, 9 detectors were deployed during the spring and summer seasons (Figure 3-2). Detailed descriptions of the survey design, methods, and results of these surveys are included in the Fall 2009 Radar and Acoustic Survey Report (Stantec 2011a) and the Spring 2010 Avian and Bat Survey Report (Stantec 2011b). At a meeting on April, 1, 2010 the NHFGD and USFWS expressed an interest in adding mist netting to the study plan at Wild Meadows due to the recent decline in bat populations as a result of White-nose Syndrome (WNS) and the presence of a bat hibernaculum in the Project vicinity. Therefore, a mist nest survey was conducted in Fall 2011. Mist nets were erected in five locations, and detailed descriptions of the survey design, methods, and results are included in the 2011 Mist Net Survey Report (Stantec 2012)

3.4.3 Risk Assessment Endpoints

Two assessment endpoints were chosen for the evaluation of risk to bats associated with the Project: potential collision mortality of bats (assessment endpoint 6); and potential loss of habitat or displacement (assessment endpoint 7). These endpoints were chosen so as to separately evaluate risk of collision mortality to bat species and indirect habitat loss associated with the Project. Measurement endpoints were identified for each assessment endpoint as specified in Table 3-7. Measurement endpoints consisted of results of literature review (6a, 7a), on-site acoustic and mist net bat surveys (6b), a habitat assessment (7b), and analysis of weather data (6c). Literature review included a review of information on interactions between bats and wind turbines, collision mortality data from operational wind projects, information on the distribution of bat species (including RTE species) in the vicinity of the Project area, including maternity colonies and hibernacula, and information regarding the effects of habitat loss and conversion on bats.

Table 3-7. Assessment and measurement endpoints used to assess risk to bats at the Wild Meadows Wind Project.

Assessment Endpoint		Measurement Endpoints		Measurement Endpoint Response
6	Potential collision mortality of bats	6a	Literature Review	Measure species composition and relative abundance, and determine activity patterns of bats in the Project area. Relate these to known patterns of collision mortality from operational sites. Document patterns in weather and relate these to patterns of collision mortality from operational sites.
		6b	Acoustic and Mist Net Bat Surveys	
		6c	Weather Analysis	
7	Potential habitat loss or displacement of bats from the Project area	7a	Literature Review	Document available habitat pre-construction and potential effects of habitat loss.
		7b	Habitat Characterization	

Each measurement/assessment endpoint pair was assigned a weight based on the attributes and criteria described in the methods section. Overall, the measurement endpoints were evaluated as medium to low weight-of-evidence (Table 3-8). However, the relatively low scoring of measurement endpoints used in the risk assessment is not a result of insufficient pre-construction data, which provided a thorough characterization of bat activity in the Project area. Instead, the uncertainty stems from the lack of understanding of the connection between pre-construction surveys and rates of mortality and displacement once facilities become operational. Moreover, the stressor is not yet present in the landscape. It is important to note that additional pre-construction surveys would not necessarily increase the rankings of these attributes or the ability to accurately predict risk to bats, specifically because additional field survey data would not further understanding of the link between pre-construction and post-construction conditions until the Project is constructed. However, acoustic and mist net bat surveys provide the opportunity to document bat activity levels and general species composition at the Project area and relative to other projects and is useful for comparing pre-construction survey data from similar projects and habitats that have been developed and also conducted post construction mortality studies.

Table 3-8. Weight-of-evidence evaluation of measurement endpoints used to evaluate risk to bats at the Wild Meadows Wind Project.

Attributes	Measurement Endpoints					Rationale
	Collision Mortality			Indirect Impacts		
	6a Literature Review	6b On-site Acoustic and Mist Net Surveys	6c Weather Analysis	7a Literature Review	7b Habitat Characterization	
I. Strength of Association between Assessment and Measurement Endpoint						
Degree of Biological Association	Medium	Low	Low	Medium	Medium	Literature review can directly characterize patterns in collision mortality and indirect displacement at existing wind farms only. Pre-construction acoustic surveys and mist net surveys can document bat activity patterns and species composition, although these results can only be used indirectly to characterize risk of collision or indirect impacts, as relationships between pre-construction surveys and post-construction surveys have not been established.
Stressor/Response	Medium	Medium	Low	Medium	Medium	Increased exposure to wind turbines presumably increases risk of collision, although the mechanisms explaining collision mortality remain ambiguous. Relationships between weather variables and collision rates have been identified as potentially explaining variability in rates of collision morality. However, patterns in collision mortality and indirect impacts will likely be similar between sites, so as more information is gathered, this relationship will become stronger, for at least some species.
Utility of Measure	Medium	Medium	Medium	Medium	Medium	The methods used for acoustic and mist net bat surveys (and the literature that reports their results), and weather documentation are well accepted and developed by a third party, but they have limited applicability and are relatively insensitive for determining risk.
II. Data Quality						
Data Quality	Medium	Medium	Medium	Medium	Medium	The objectives of documenting activity patterns of bats were met by acoustic surveys. The objectives of documenting species composition of bats were met by both acoustic surveys and mist net surveys. However, results of these types of ecological surveys are inherently subject to variation and require extrapolation to relate to the assessment endpoints.
III. Study Design						
Site Specificity	Low	High	High	Medium	High	Acoustic and mist net surveys provide site-specific data that could provide means for comparison of pre- and post-construction results. Literature review of post-construction mortality surveys at other sites has uncertain applicability to the exposure site. Habitat characterizations directly address loss/conversion at the site of interest and literature review of habitat loss at other areas is probably moderately applicable.
Sensitivity	Low	Low	High	Low	Medium	Acoustic surveys can detect slight changes in activity levels, although these changes would not necessarily be correlated to the stressor. Mist net surveys cannot detect changes in species presence. Habitat characterizations can detect moderate level changes in bat habitat from measuring loss/conversion.
Spatial Representativeness	Low	Medium	High	Low	Medium	Acoustic surveys were conducted at three locations and characterized broad patterns in activity. Habitat characterizations were general, focusing on dominant conditions and major losses/conversions expected. Mist net surveys were conducted at 5 locations, targeting probable northern long-eared bat habitat and probable travel corridors for all bat species.
Temporal Representativeness	N/A	Medium	High	N/A	N/A	Acoustic surveys sampled one fall migration period, (the season in which bat mortality is expected to be highest), the following spring migration period, and the following summer. Mist net surveys sampled one summer season.
Quantitative Measure	Low	Low	Medium	Medium	Medium	The magnitude of response to the stressor cannot be tested statistically for acoustic or mist net surveys, because the exposure has not yet occurred. Statistical tests, such as those used in spatial statistics in GIS analysis of fragmentation or connectivity, could be conducted and applied to a predictive model of impact to bat habitat.
Standard Method	N/A	High	High	N/A	Medium	Fairly standardized methods exist for acoustic and mist net surveys, but they are only moderately applicable to assessing exposure. Similarly, standard methods exist for collection of weather data, but not for relating these data to risk of bat collision mortality. Methods for habitat characterizations are well documented and application to evaluating loss/conversion of bat habitat could be standardized.
Overall Endpoint Value*	Low/Medium	Medium	Medium/High	Low/Medium	Medium	* Overall endpoint value was determined by determining the number of attributes ranked as “low”, “medium”, and “high” for each measurement endpoint.

4.0 Discussion

4.1 RAPTORS

4.1.1 Raptor Collision Mortality (Assessment Endpoint 1)

4.1.1.1 Literature Review (Measurement Endpoint 1a)

Regional Migration Patterns

New Hampshire is located within the "Eastern Continental Hawk Flyway[8]," which extends from the Canadian Maritimes south to eastern Florida and, at its widest, measures the width of North Carolina and Tennessee. Within this large area, raptors tend to concentrate along linear ridges, in which atmospheric conditions create deflective updrafts or "thermals" that raptors can use to fly long distances with minimal energy exertion (Berthold 2001). The geography of the area where the Project is located is characterized by moderate topography consisting of granite hills and peaks interspersed with small lakes and narrow stream valleys (Sperduto and Nichols 2004). Updrafts are formed along the side slopes of ridges which raptors use in order to fly long distances with minimal exertion (Berthold 2001). In the Eastern Continental Hawk Flyway, raptor migration also tends to concentrate along the shores of large bodies of water including lakes as many species of raptor avoid crossing large bodies of water (Kellogg 2007).

Regional Raptor Species

Fifteen species of raptors are expected to occur in New Hampshire during the breeding and/or migration periods based on their normal geographic range. These species are American kestrel (*Falco sparverius*), bald eagle (*Haliaeetus leucocephalus*), broad-winged hawk (*Buteo platypterus*), Cooper's hawk (*Accipiter cooperii*), golden eagle (*Aquila chrysaetos*), merlin (*Falco columbarius*), northern goshawk (*Accipiter gentilis*), northern harrier (*Circus cyaneus*), osprey (*Pandion halaeetus*), peregrine falcon (*Falco peregrinus*), red-shouldered hawk (*Buteo lineatus*), red-tailed hawk (*Buteo jamacensis*), rough-legged hawk (*Buteo lagopus*), sharp-shinned hawk (*Accipiter striatus*), and turkey vulture (*Cathartes aura*)[9].

Results of Regional Bird Surveys

Hawk Migration Association of North America: From 2005 to 2009, a total of 13 species of raptors, including turkey vultures, have been documented at the Little Round Top HMANA site, located in Bristol, New Hampshire (approximately 15 miles east of the Project). Passage rates during this time ranged from 675 raptors in 2005 to 3,381 raptors in 2008 (Appendix B, Table 1). Broad-winged hawk (annual mean = 1,712) was the most commonly observed species during the five seasons, followed by sharp-shinned hawk (annual mean = 92), and osprey (annual

[8] The Eastern Continental Flyway includes the Maritime Provinces; New England; New York (south and east of a line from Jamestown to Utica to the north end of Lake Champlain); Pennsylvania (all except Erie County); Mid-Atlantic States through Georgia, West Virginia, Kentucky and Tennessee; Florida east of a line from Lake Seminole south to Apalachicola (Kellogg 2007).

[9] While turkey vultures are not phylogenetically considered true raptors, they are diurnal migrants that exhibit flight characteristics similar to *Buteos, Accipiters* and other *Falconiformes* species. Therefore, vultures are typically included during hawk watch surveys.

mean = 50). State-listed species that were observed from Little Round Top included the endangered northern harrier and golden eagle, the threatened bald eagle and peregrine falcon, and osprey and American kestrel, which are species of special concern. As previously stated, osprey was one of the most commonly observed species and bald eagle (annual mean = 36) and American kestrel (annual mean = 24) were somewhat common. The northern harrier, golden eagle and peregrine falcon were relatively uncommon with a mean observation rate of less than five birds per season.

Raptor Survey: Groton, Lempster, and Granite Reliable Wind Farms: The 2009 survey results for Little Round Top identified a similar list of species when compared with Groton, Lempster and Granite Reliable Wind Farms and the Wild Meadows Wind Project, although the total number of raptors observed at Little Round Top was higher than any of these other sites (Appendix B, Table 2). The difference in the total number of raptors observed may reflect the number of observers conducting Hawk Watch surveys: up to nine observers per survey day were documenting raptors at a single observation point at Little Round Top, while surveys conducted at Groton, Granite Reliable, and Wild Meadows relied on two observers with one observer at each of two survey locations, and Lempster used a single observer. Other factors influencing the difference in results among sites may include variations in visibility and topography.

Among the seasons surveyed at the HMANA and at the proposed wind project sites (included in Appendix B Table 2), species composition was generally the same with the exception of golden eagle (only observed at Groton), peregrine falcon (only observed at Lempster and Groton), red-shouldered hawk (*Buteo lineatus*; only observed at Groton), and rough-legged hawk (*Buteo lagopus*; only observed at Wild Meadows). The number of individuals observed was greatest at Little Round Top.

The observers at the Groton, Lempster, Granite Reliable, and Wild Meadows wind projects collected flight height data, while the observers at the HMANA site did not. During spring 2010 surveys at Wild Meadows, of the 6 birds seen from the western observation location that flew over the current Project area, 5 (83%) occurred at heights below 150 m. Of the 168 birds observed over the Project area during spring 2010, as seen from the eastern observation location, 141 birds (84%) occurred at flight heights below the proposed maximum turbine height. During fall 2010, of 5 birds seen in the Project area from the western observation site, 3 birds (60%) occurred at flight heights below the proposed maximum rotor height. Of 239 birds seen from the eastern observation site, 159 (67%) occurred at flight heights below 150 m. These results were comparable to the percentages of raptors observed below maximum turbine height at the other wind sites in New Hampshire (Appendix B, Tables 14 and 15):

- Groton, Spring 2009, 25% of birds within Project area were below 121 m;
- Lempster, Spring 2006, 56% of birds within Project area were below 125 m;
- Granite Reliable, Spring 2010, 64% of birds were below 125 m as seen from Dixville Peak, and 76% of birds were below 125 m as seen from Owlhead Mountain.

- Groton, Fall 2009, 58% of birds within Project area as seen from Tenney observation location were below 121 m, and 79% of birds within Project area as seen from Crosby and Bald Mountains were below 121 m;
- Lempster, Fall 2009, 20.8% of birds within Project area were below 125 m;
- Granite Reliable, Fall 2009, 76% of birds were below 125 m as seen from Dixville Peak, and 82% of birds were below 125 m as seen from Owlhead Mountain.

New Hampshire Breeding Bird Atlas: Raptor species observed during Breeding Bird Atlas surveys in the Grafton, NH block included American kestrel, red-shouldered hawk, red-tailed hawk, sharp-shinned hawk, and turkey vulture. All five species were identified as possibly breeding, with the exception of American kestrel which was confirmed as breeding. Only two raptor species were identified along the Danbury, NH block: American kestrel was confirmed breeding and red-shouldered hawk was possibly breeding. In the Mount Cardigan, NH block, the only raptor species identified was the barred owl (*Strix varia*), identified as possibly breeding.

North American Breeding Bird Survey: The Wilmot, NH BBS route documented the occurrence of seven species of raptor and one owl during breeding seasons from 1966 to 2010: American kestrel, broad-winged hawk, northern harrier, red-shouldered hawk, red-tailed hawk, sharp-shinned hawk, turkey vulture, and barred owl (Appendix B, Table 5).

The National Audubon Society Christmas Bird Count: The Audubon Christmas Bird Count survey documented the occurrence of six species of raptor and two owl species from 2000 to 2009: bald eagle, barred owl, Cooper's hawk, northern harrier, northern saw-whet owl, red-tailed hawk, rough-legged hawk, and sharp-shinned hawk (Appendix B, Table 6).

The National Audubon Society Important Bird Area Program: The Project area does not fall within any of the 17 designated IBAs in New Hampshire (NH Audubon 2009). The nearest IBAs are Squam Lake located approximately 15 miles to the northeast of the Project area and the Merrimack River Floodplain located approximately 15 miles to the southeast (Figure 2). The Squam Lake IBA supports breeding common loons and bald eagles, and is a staging area for migratory waterfowl. The Merrimack River Floodplain supports breeding bald eagles, and bank swallows, and an osprey nest along the tributaries of the Merrimack. The forested floodplains support a diverse assemblage of breeding birds and this area, along with adjacent agricultural fields, are important for a variety of migratory birds including waterfowl, swallows, and numerous species of passerines.

Priority Species Lists: NH lists golden eagle and northern harrier as endangered; bald eagle and peregrine falcon as threatened; and American kestrel and osprey as species of concern. The USFWS lists bald eagle and peregrine falcon as birds of Conservation Concern. NH PIF lists bald eagle, Cooper's hawk, golden eagle, northern harrier, osprey, and peregrine falcon as high priority species, and merlin and sharp-shinned hawk as species to watch (Appendix B, Table 7).

Northern harrier breeds in open habitats such as grasslands and dry fields, habitats that do not occur on the Project ridgelines. Both the golden eagle and peregrine falcon breed on cliffs or ledges near expanses of open habitat; although the peregrine falcon is a more adaptive species and will nest on tall buildings in developed areas (NHFGD 2012). Although it's possible that these species could migrate over the Project area during migration, it is unlikely they would breed on site due to the lack of suitable breeding habitat. Based upon available information, golden eagles have not successfully bred in New Hampshire since 1956 and the last known home range of a golden eagle in New Hampshire has not been occupied since 1982 (NHFGD 2005, NHFGD 2012). The nearest known peregrine falcon nests are located on Bear Mountain in Hebron and Rattlesnake Mountain in Rumney, New Hampshire (Stantec and NH Audubon 2009). These nest sites are approximately 6 miles and 15 miles to the northeast of the Project area, respectively. Stantec and the NH Audubon conducted surveys of the Rattlesnake Mountain nest site during the summer of 2009 and found that most observed foraging activity occurred over the Baker River Valley to the east of the nest site (Stantec and NH Audubon 2009).

Local Peregrine Falcon Breeding Information

Peregrine falcons are listed as threatened in New Hampshire, recently down-listed from endangered. Peregrine falcon nests (aeries) are typically located on cliffs or anthropogenic structures such as bridges and tall buildings. The two aerie locations in New Hampshire that are closest to the Project include: the Bear Mountain aerie, approximately 6 miles northeast of the Project area in Hebron, NH, and the Rattlesnake Mountain aerie, approximately 15 miles northeast of the Project area in Rumney, NH. Peregrine falcons have been documented at the Rattlesnake Mountain aerie during the breeding season for the past 19 years (since 1994), and have been confirmed to be actively breeding there for 18 years (since 1995) (NH Audubon pers. comm.). The falcons have had a historic presence at the Rattlesnake aerie since at least 1955 (NH Audubon pers. comm.). Peregrine falcons have been documented at the Bear Mountain aerie during the breeding season for the past 7 years (since 2006), and have been confirmed to be breeding at the site for the past 6 years (since 2007); however, their historic presence at the Bear Mountain site is unknown (NH Audubon pers. comm.). Stantec and the NH Audubon conducted surveys of the Rattlesnake Mountain nest site during the summer of 2009 and found that most foraging by these birds occurred over the Baker River Valley to the east of the nest site (Stantec and NH Audubon 2009).

Regional Eagle Telemetry Data

An intensive eagle migration survey was initiated by the National Aviary in conjunction with Powdermill Avian Research Center and a number of other non-profit institutions. Eagles were captured either in their winter ranges in the mid-Atlantic states or in their summer ranges in northern Canada and were fitted with satellite transmitters to track their movements during migration. The data are currently publicly available in rough form and provide some insight into the specific flight paths, timing of occurrence, and behavior patterns of golden and bald eagles. At present, the study has data for 10 actively tracked golden eagles. The time periods of available data vary among individual birds and include winter 2007, spring 2008, fall 2008, and spring and summer 2009 (National Aviary 2009). Available data exist for 7 actively tracked bald eagles. The time periods of available data vary among individuals and include Fall 2007, summer and fall 2008, and spring and summer 2009 (National Aviary 2009).

Although the resolution of the publicly available telemetry data from the eagle tracking project does not permit determination of whether eagles flew directly over the Project area, 5 of the 10 tracked golden eagles occurred at locations along the Appalachian Mountain chain either during their migration or over-wintering periods (Figure 4-1; National Aviary 2009). Specifically golden eagle number 603 occurred at some locations over central New Hampshire as it migrated from its breeding grounds in Canada to its wintering grounds in West Virginia between September 3, 2008 and October 16, 2008 (Figure 4-1; National Aviary 2009). Four of the tracked bald eagles occurred at locations over New Hampshire either during their late-summer/early fall dispersal, spring northbound migration, or southbound fall migration (Figure 4-2; National Aviary 2009). In particular, bald eagle number 63 occurred over south-central New Hampshire during its southbound migration at some point between September 16 and September 20, 2007 (Figure 4-2; National Aviary 2009).

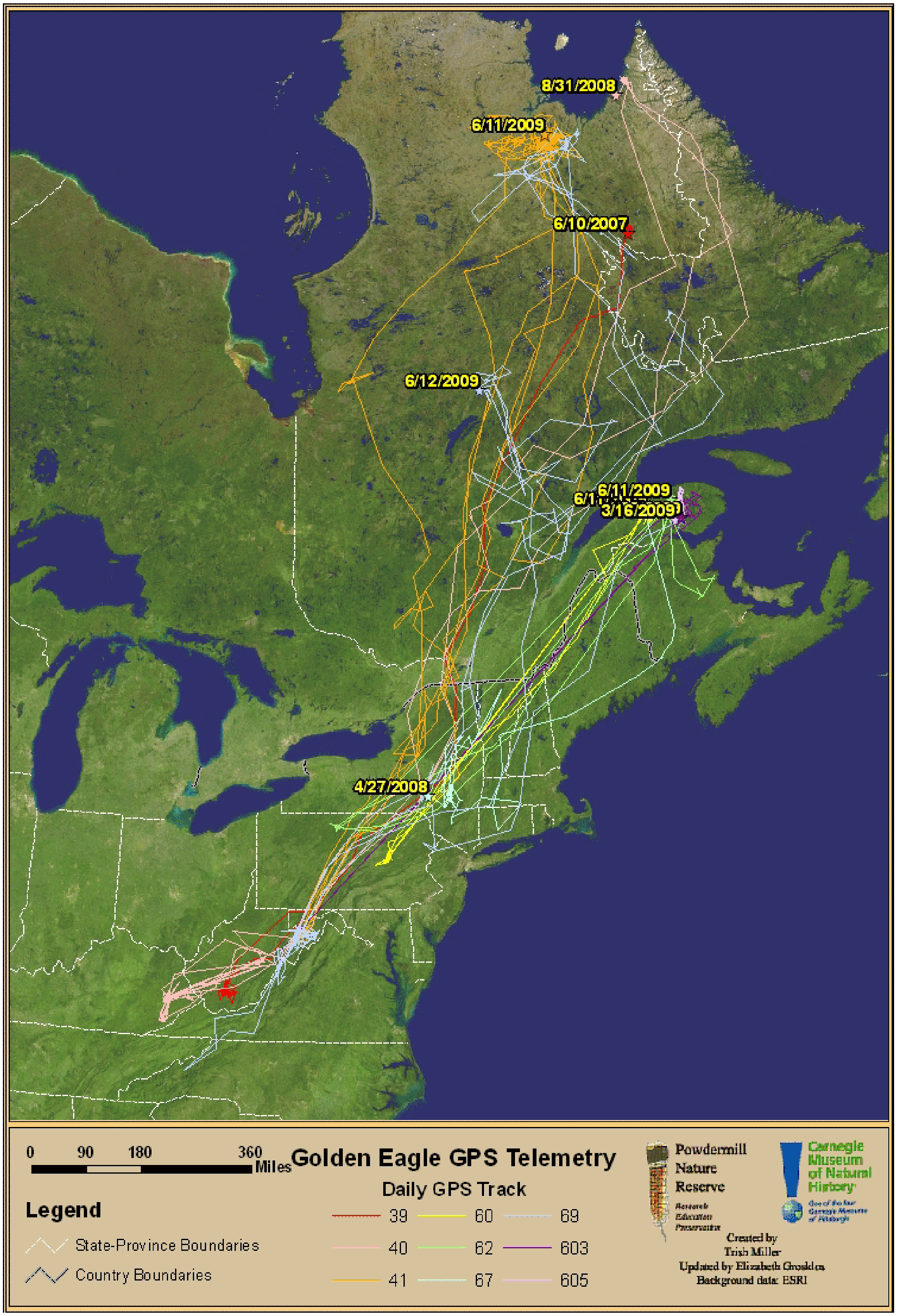

Figure 4-1. Static map of telemetry locations for golden eagles tracked by the National Aviary between fall 2006 and summer 2009 (National Aviary 2009).

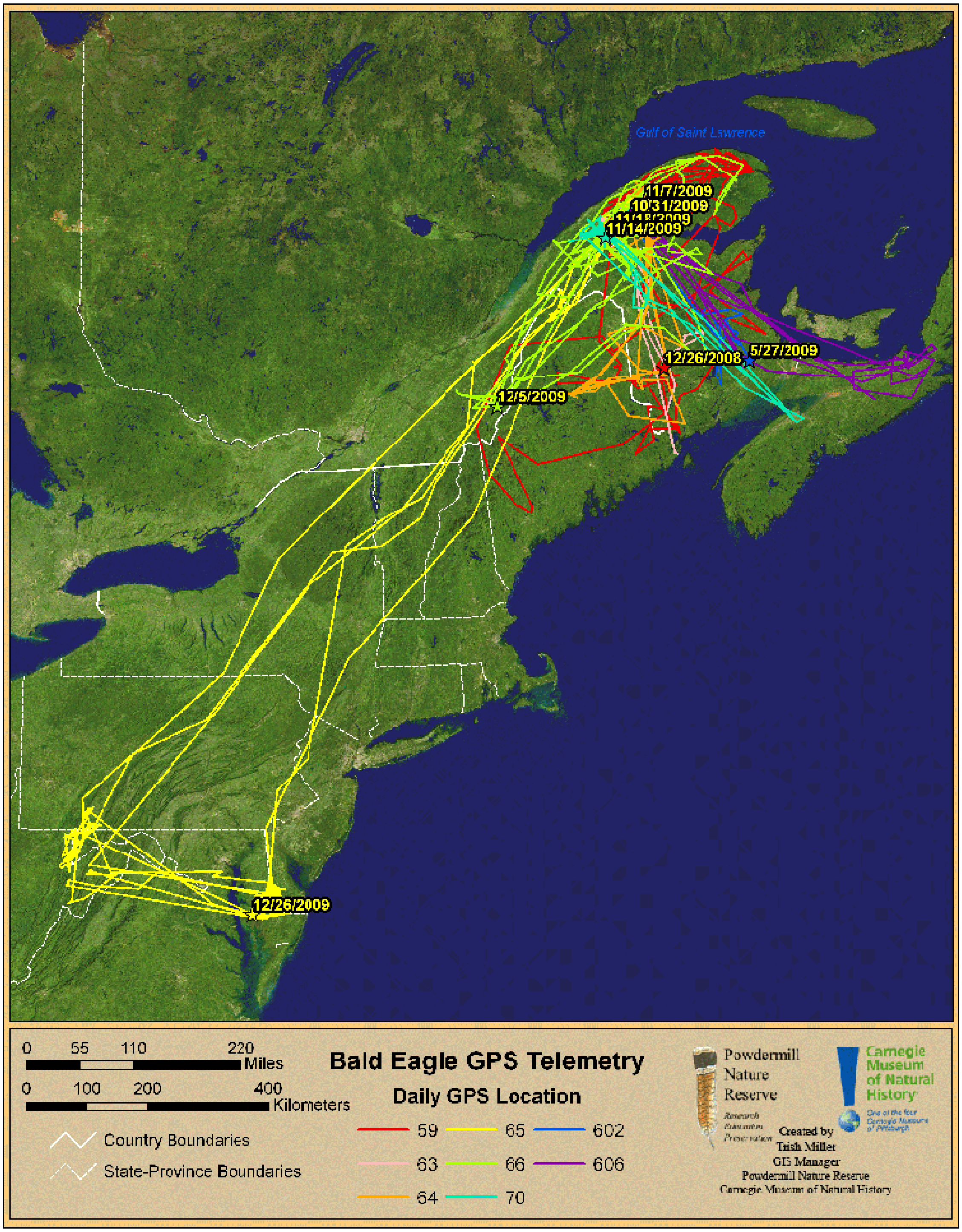

Figure 4-2. Static map of telemetry locations for bald eagles tracked by the National Aviary between fall 2006 and summer 2009 (National Aviary 2009).

Another golden eagle telemetry study was conducted in the northeast which followed the movements of 8 birds from November 2006 to May 2009 (Katzner et al. 2012). This study found that golden eagles making local movements flew at lower altitudes than those making migratory movements. Migratory movements averaged 135 m to 341 m above ground level, while local movements averaged 63 m to 83 m above ground level (Katzner et al. 2012). In addition, golden eagles flew at lower altitudes when traveling over steep slopes and cliffs rather than over gentle slopes and flats. Finally, golden eagles flew closer to areas with high-class winds; although again, this result differed by activity class, with locally moving birds flying closer to high-class winds than migratory birds (Katzner et al. 2012). This study demonstrates that golden eagles are at greatest risk during local movements over steep slopes and cliffs.

Raptor Mortality Data

The fatality of raptors at California wind farms was the catalyst for investigations of the effects of wind energy projects on birds. The high rates of raptor mortality that have been found in California, particularly at Altamont Pass, are attributable to at least five factors: high raptor density; high prey density; high turbine density; short lattice towers; and fast spinning blades that appear to blur at high wind speeds. The combination of these factors is unique to older projects within parts of California, although not all projects within that state include all of these factors.

Modern projects that have been constructed within the last 5 to 10 years have significantly different characteristics than those found specifically at Altamont Pass and other California developments with high raptor density. In general, newer sites are within areas with much lower raptor density and probably lower prey densities (Erickson *et al*. 2002). Additionally, newer facilities have widely spaced turbines, smooth tubular towers, and blades that spin slowly enough to remain visible even at high wind speeds. These factors are thought to have contributed to lower rates of raptor mortality in the east than those documented in California. While there have been more than 100 raptor mortalities documented per year at some western projects such as the Altamont Pass, with overall estimates of thousands killed annually at that project alone, several recent studies conducted in the eastern U.S. have documented relatively low raptor mortality: there have been 51 raptor fatalities reported among 45 studies at 31 operational projects in the eastern U.S. from 1997-2012 (Appendix B, Table 9a and b). Species of raptor involved in collisions in the eastern U.S. include American kestrel, broad-winged hawk, Cooper's hawk, osprey, red-tailed hawk, sharp-shinned hawk, turkey vulture, and unidentified raptor (Appendix B, Table 9a and b). Four of these raptor fatalities occurred in New England (1 raptor has been documented in New Hampshire); however, the red-tailed hawk discovered at the Stetson I Project in Maine was electrocuted by a powerline.

Locally, pre-construction surveys conducted at the now-operational Lempster Wind Project documented a seasonal passage rate of 3.3 raptors per hour (raptors/hr) in fall 2005 and 1.3 raptors/hr in spring 2006. Pre-construction surveys at the Groton Wind Project observed 1.4 raptors/hr in spring 2009 and 4.13 raptors/hr in fall 2009. Pre-construction raptor surveys at the Granite Reliable Wind Project documented 1.65 raptors/hr and 1.84 raptors/hr from Dixville Peak and Owlhead Mountain, respectively, in fall 2009; and documented 0.21 raptors/hr and 0.46 raptors/hr from Dixville Peak and Owlhead Mountain, respectively, in Spring 2010. These results were similar to those documented at the Project: 0.83 raptors/hr from the western observation site and 2.65 raptors/hr from the eastern observation point in spring 2010; 0.76 raptors/hr from the western observation site and 4.2 raptors/hr from the eastern observation site in fall 2010 (see section 4.1.1.2). (Note surveys were not simultaneous with two observers at either the Lempster or Granite Reliable Wind Projects.) Although survey effort varied slightly among the projects, the overall spring and fall passage rates were similar, and the greatest passage rates at these sites were generally observed during the fall migration season. No raptor fatalities were documented at the Lempster Wind Project during searches conducted between April 15 and June 1, 2009, or during searches conducted in spring (April 15 – June 1) and fall (July 15 – October 31) 2010 (Tidhar et al. 2010, Tidhar et al. 2011). There were no raptor fatalities documented at the Granite Reliable project during fatality surveys conducted from the end of April to the end of October, 2012; there was 1 red-tailed hawk fatality found during searches from mid April to the end of October, 2013 (West 2013, preliminary data).

While the ability of raptors to avoid turbines likely depends on a variety of factors, limited studies have attempted to quantify or estimate raptor avoidance rates, either through on-site observation or modeling. Birds presumably avoid encountering turbines by seeing the blades or detecting the motion of spinning blades, or by acoustically detecting them (Dooling 2002). Avian turbine avoidance rates have been calculated, using a model developed by Whitfield and Madders (2006) known as the "Band Model," at several existing wind farms in the U.S. where mainly geese and raptor species were estimated to have avoidance rates greater than 95 percent (Fernley *et al.* 2006). Vultures, while often common in and around wind facilities, have also collided with turbines infrequently (NRC 2007); turkey vulture accounted for 7 (14%) of 51 documented raptor fatalities at operational projects in the eastern U.S., and no turkey vultures have been documented to-date at projects in New England (Table 9a and 9b). Golden eagles were reported to have an estimated turbine avoidance rate of 99.5 percent during surveys at a U.S. facility (Chamberlain *et al*. 2006). However, limitations to these calculations include failure to account for differences among bird flight patterns and behaviors under a range of conditions, and a general lack of information and data about avoidance behaviors of birds (Chamberlain *et al.* 2006).

Direct observations of turbine avoidance behavior by raptors were made by researchers documenting movement patterns and flight behaviors of birds at the Buffalo Ridge facility in Minnesota. The project area at Buffalo Ridge consists of upland prairie, prairie wetlands, agricultural land, woodlands, and forested ravines. Birds seen flying through turbine strings often adjusted their flight when turbine blades were rotating and typically made no adjustments when turbines were not operating, supporting the theory that birds can detect blade movement by sight or sound. American kestrels were often seen at the height of the rotors and within 15 m (50') of turbines. However, no kestrels were found during fatality searches at this site. *Buteos* were often observed at the height of the rotors, but were infrequently seen within 31 m (100') of the towers. No *buteo* morality was reported at this facility (Osborn *et al.* 1998). Breeding passerines were believed to be at a decreased risk of collision with the turbines at the Buffalo Ridge facility because most flights occurred below blade height (Osborn *et al*. 1998).

Due to the overlap in occurrence of seasonally local and migrant raptors at study locations, it is difficult to determine if the raptor fatalities reported in Appendix B, Table 9a occurred during localized movements or during long-distance migration movements. Available carcass discovery dates indicate that collision events could occur during both breeding and migration seasons (NRC 2007). Overall, literature review suggests that, while a variety of raptors are present in the Project area during spring and fall migration, as well as during the breeding season, the likelihood of raptor collision morality at the Project will be low, given the low overall rates of collision mortality observed at other sites in the eastern U.S., particularly in New England.).

Kerlinger and Guarnaccia (2008) suggested in the Groton Phase I Avian Risk Assessment that the number of raptor fatalities due to that Project would be expected to be small and to primarily involve seasonally local species verses migrating raptors. For listed raptor species that may occur in the Project area, Kerlinger and Guarnaccia (2008) expected low risk of collision because peregrine falcon would hunt primarily over Baker River Valley and would only occasionally occur along the ridge; and Cooper's hawk would typically forage within forest canopy and along forest edges, and would mainly remain below the rotor zone. There was 1 raptor fatality found during searches in 2013 at Groton (West 2013, preliminary data). Field surveys conducted for the Lempster and Granite Reliable Projects also indicated low risk for raptor collision mortality, and there were no raptor fatalities documented to-date at either project (Tidhar et al. 2010 and 2011, Curry and Kerlinger 2013).

Due to regional concern for risk of impacts to peregrine falcons, additional turbine collision mortality data specific to peregrine falcon is included here. Peregrines are among species involved with collisions at the Altamont Pass Wind Resource Area in California (ICF Jones and Stokes 2009). However, the Altamont Pass Wind Resource area has unique topographical features, differences in the abundance of raptors and prey species, as well as outdated turbine design features which are not characteristic of modern wind farms in the eastern U.S. The only documented peregrine falcon collision fatality in the eastern U.S. was at a wind farm located in a wetland-setting in Atlantic City, New Jersey (NJDEP 2009). There have been no documented peregrine falcon fatalities in New England.

4.1.1.2 On-site Field Surveys (Measurement Endpoint 1b)

There were 10 and 12 species of raptor observed during on-site raptor migration surveys in spring and fall 2010, respectively (Stantec 2011c). The species known to occur in the region that were not observed on-site during the 2010 surveys were golden eagle and peregrine falcon. One state endangered raptor species was observed (northern harrier) and one state threatened species was observed (bald eagle). The individual field reports provide the dates, number of individuals, locations of occurrence, and flight behaviors of each of the state listed species observed.

Species observed most frequently during the spring and fall migration surveys included broad-winged hawk, red-tailed hawk, sharp-shinned hawk, and turkey vulture. Turkey vultures and red-tailed hawks accounted for 53 and 18 percent of observations during spring migration surveys. Red-tailed hawks, broad-winged hawks, and turkey vultures accounted for 36, 18, and 17 percent of all observations during fall migration surveys, respectively.

The spring average passage rates (0.83 raptors/hr from the western observation site and 2.65 birds/hr from the eastern observation point) at the Project were within the range of average spring passage rates observed at other wind sites in the northeast, and more specifically New England (Appendix B, Table 14). The fall average passage rates (0.76 birds birds/hr from the western observation site and 4.2 birds/hr from the eastern observation site) were within the range of fall average passage rates observed at other wind sites in the northeast, and more specifically New England (Appendix B, Table 15) and were low in comparison to fall HMANA rates reported at the Little Round Top Migration Observatory from 2005-2009 (which ranged from 8.54 to 31.90 birds/hr; Appendix B, Table 1).

During spring 2010, from the western observation location, 6 observations (10%) occurred within the Project area. Of these birds, 5 (83% of the 6 in the Project area) occurred at flight heights below the proposed maximum turbine height of 150 m. At the eastern observation site, 168 observations (82%) occurred within the Project area. Of these birds, 142 (84% of the 168 in the Project area) occurred at flight heights below the proposed maximum rotor height (Stantec 2011c).

During fall 2010, from the western observation site, 5 observations (10%) occurred within the Project area. Of these birds in the Project area, 3 birds (60%) occurred at flight heights below the proposed maximum rotor height. From the eastern observation site, 239 observations (81%) occurred within the Project area. Of these birds, 159 (67%) occurred at flight heights below the proposed maximum turbine height of 150 m (Stantec 2011c).

Spring and fall raptor surveys (Measurement endpoint 1b) documented low to moderate numbers of migrating raptors above the Project area, but relatively high percentages of raptors flying below the height of the proposed turbines. While pre-construction surveys do not provide the necessary information to predict risk of collision mortality, field surveys do indicate the potential for exposure of raptors to wind turbines at the Project. However, the relatively low to moderate numbers of raptors within the Project area overall suggests a low likelihood of impact, especially when considered in light of the results of mortality surveys conducted in the eastern U.S., which have documented relatively few raptor fatalities (Table 4-1).

Table 4-1. Evaluation of risk of impacts to raptors at Wild Meadows Wind Project.

Assessment Endpoint		Measurement Endpoints		WOE Score	Risk of Impact	Magnitude of Impact	Rationale
1	Potential collision mortality of resident and migratory raptors	1a	Literature Review	Low/ Medium	Yes	Low	Low rates of raptor collision mortality observed at wind facilities in the eastern U.S., particularly in New England.
		1b	Raptor Migration Surveys and Regional Bird Surveys	Medium/High	Yes	Low	Several species of raptor, including state-listed species, were present in and around Project area during migration, although rates of raptor migration are low to moderate relative to other sites. On-site BBS surveys documented one American kestrel and one barred owl, and regional surveys indicate several raptors that breed or over-winter in the region.
2	Potential habitat loss or displacement of raptors from the Project area	2a	Literature Review	Low/ Medium	Yes	Low	Displacement of raptors documented at certain operational wind facilities, raptors continue to forage and nest within other facilities indicating the potential for impacts but a low magnitude of impact.
		2b	Habitat Characterization	Medium	Yes	Low	There are no state-listed raptor species known to breed within the Project area (all raptors observed during BBS surveys were flyovers or incidentals). Habitat impacts to raptor species in general would be similar to existing impacts in Project area.

4.1.2 Indirect Impacts (Assessment Endpoint 2)

In addition to direct impacts, indirect impacts to raptors such as habitat loss or displacement may result from development of the Project. Impacts may include displacement from the direct development area due to loss of habitat, and for certain species, displacement from areas with increased edge habitat or forest fragmentation. Other species may benefit from the creation of forest edge, which may provide preferred foraging habitat. Species that are sensitive to human presence and construction or maintenance activities may also be displaced. Displacement may result in loss of habitat or decreased breeding success. Certain raptor species would be expected to be more susceptible to displacement impacts or loss of breeding habitat than others. The potential indirect impacts to raptors is dependent on species' use of the Project area, the availability of suitable breeding or foraging habitat on-site, and species' tolerance for human disturbances.

4.1.2.1 Literature review (Measurement Endpoint 2a)

Limited data exist regarding raptor displacement from wind farms in the east. However, data from existing facilities in the west and upper mid-west can be used to extrapolate potential behavioral patterns for similar species in the east. For three years after construction of a facility in Wyoming, a pair of golden eagles successfully nested within 0.8 km (0.5 mi) of the facility (NRC 2007). A Swainson's hawk nested within 0.8 km of a wind farm in Oregon (NRC 2007). Golden eagle breeding territories were monitored in 2000 and 2005 at a facility in California, and the same nesting territories were used during both years (NRC 2007). Within 2 miles of the Stateline facility in Oregon and Washington, raptor density remained unchanged during a two year post-construction study (NRC 2007).

The majority of available studies conducted in the U.S. indicate that raptors continue to use the area surrounding wind developments. However, breeding habitat displacement was observed at a wind farm in Minnesota. After development of the Buffalo Ridge Wind Farm, raptors continued to nest in the area surrounding the Project; however, no nests were found in similar habitats within the 32 sq. km (19.9 sq. mi) facility (NRC 2007). Observed raptors, however, continued to use the Project area while foraging or flying. American kestrels were often seen flying within 15 m (49.2') of turbines (Osborn *et al*. 1998). However, buteos were infrequently seen within 31 m of the towers (Osborn *et al*. 1998).

Based on these results, the potential for indirect impacts to raptors exists at modern wind facilities, although the magnitude of impacts appears to be low (Table 4-1). In addition to displacement, creation of edge habitat and clearing for turbine pads will likely create foraging habitat for certain raptor species, although this is not expected to have a significant effect on the distribution of raptors.

In the Groton Phase I Avian Risk Assessment, Kerlinger and Guarnaccia (2008) indicated that subtle effects to raptors associated with disturbance and displacement could occur at that project. Although a small percentage of forest-interior habitats would be removed when developing the Project, impacts were expected to be similar to current timber harvest activities which could currently have the same type of effect on raptor breeding habitat even if the Project were not constructed. Disturbances could occur for raptors nesting in the vicinity of construction sites; however, since habituation was observed at the Erie Shores Wind Farm, Ontario for bald eagle, Cooper's hawks, and red-tailed hawk, Kerlinger and Guarnaccia (2008) expected that habituation would occur for some raptor species nesting in vicinity of that project.

4.1.2.2 Habitat Characterization (Measurement Endpoint 2b)

Due to its moderate elevation, the dominant tree species in the Project area include sugar maple (*Acer saccharum*), yellow birch (*Betula alleghaniensis)*, and American Beech (*Fagus grandifolia*), which are typical of northern hardwood – conifer forests. This forest community is the most common in the northern half of the State of New Hampshire. Some small pockets of red spruce (*Picea rubens*) and balsam fir (*Abies balsamea*) are present, but are limited to the ridge summits. Common understory species include regenerating canopy species (e.g., sugar maple, yellow birch, and American beech), hobblebush (*Viburnum lantanoides*), striped maple (*Acer pensylvanicum*), and white birch (*Betula papyrifera*). The Project area ridgelines all show signs of timber harvesting activities as evidenced by skidder trails and clear cuts in various stages of regeneration.

Habitat exists for some species of breeding and over-wintering raptors including sharp-shinned hawk, Cooper's hawk, and red-shouldered hawk; however, it does not provide the preferred breeding habitat of state-listed species such as northern harrier (state endangered), bald eagle (state threatened), or peregrine falcon (state threatened). One American kestrel was observed as a fly over during the spring 2010 breeding bird survey (and one barred owl, not typically included in a discussion of diurnal raptors, was observed as an incidental observation). Initiation of breeding is typically earlier for raptors than for other avian groups like passerines, and raptors may be more easily detected early in their breeding season when establishing breeding territories. This may explain why only one raptor was observed during the breeding bird survey. Several species of raptor were however detected during regional bird surveys conducted during the breeding season and during the winter.

The development of new access roads and clearings for the turbines will result in new forest disturbance. However, as this type of habitat disturbance is already present in the Project area in the form of existing logging areas, skidder trails and forest roads, log yards, and evidence of older skidder trails. The composition of raptor species that may occur in the Project area is not expected to change dramatically after the proposed development, based on the fact that the Project infrastructure will affect only a very small percentage of available habitat. Whereas species categorized as "forest interior" species could be more sensitive to development of the Project, the majority of available habitat is currently disturbed and subject to some level of human presence and activity.

Species including red-tailed hawk benefit from the creation of cleared areas near woodlands (Preston and Beane 1993). The creation of roads at the proposed Project site may increase foraging habitat for such species. However, the presence of operating turbines or maintenance personnel may discourage more sensitive species such as red-shouldered hawk from breeding or foraging in the area immediately surrounding the turbines.

Magnitude of indirect impacts associated with breeding or over-wintering habitat loss or displacement from habitat is anticipated to be low for raptors based on the results of the habitat characterization (Measurement Endpoint 2b), as the Project will result in a relatively small amount of habitat loss relative to the landscape (Table 4-1).

4.1.3 Conclusions

Whereas available data do not necessarily allow for an accurate prediction of collision rates, timing of collisions, and species involved, the overall lack of raptor mortalities documented at existing facilities suggests very low risk of impact to this species group. Reasons for this low potential impact are not completely understood, but potentially related to the large size of modern turbines and slow-moving blades, which are likely more easily avoided by diurnally active raptors than the older generation, fast-spinning turbines used at the Altamont Pass. Anecdotal observations of raptors avoiding turbines suggest that raptors are generally able to detect and avoid them, and that collisions are unusual.

Post-construction studies and other literature on raptor collision mortality in the eastern U.S. (measurement endpoint 1a) have documented very few raptor fatalities, and suggest that raptors are not vulnerable to population impacts associated with collision mortality at modern wind facilities, particularly in the eastern U.S. More specifically, the nearby Lempster Wind Project, which is similar in elevation and habitat, did not document any raptor fatalities during 2009 or 2010 post construction surveys (Tidhar et al. 2010 and 2011). There were no raptor fatalities documented at Granite Reliable, during the first year of operation at the project in 2012 (Curry and Kerlinger 2013). There was 1 raptor fatality documented at the Groton project during the first year of operation in 2013 (West 2013, preliminary data). On-site raptor surveys (measurement endpoint 1b) documented low to moderate numbers of raptors passing through the Project area during spring and fall migrations, indicating a potential for collision events to occur, although low numbers of raptors observed overall suggest a low magnitude of impacts (Table 4-1). The two measurement endpoints addressing potential indirect impacts to raptors at the Project both indicated a potential for impact, as any type of habitat modification or land clearing can be expected to affect the distribution and species composition of raptors in the immediate area, but a low magnitude of impact, as the amount of land clearing associated with the Project will be minimal in comparison to the amount of available habitat and will result in habitat alterations similar to those already present in the landscape (Table 4-1).

Field surveys and literature review did not document anything particular about the Project area that would suggest an increased risk to raptors posed by the site, other than the location of the Project within a system of parallel ridges in a region of the country through which large numbers of raptors migrate. Additionally, peregrine falcons nest at two sites within 15 miles of the Project, although this does not necessarily indicate risk of direct or indirect impacts. Spring and fall raptor migration surveys at the Project documented low to moderate passage rates relative to other wind sites in the northeast, suggesting that the Project itself does not appear to be a point of concentration during migration. Overall, the measurement endpoints indicated a potential risk of direct and indirect impacts, as raptors do migrate through the Project area, and the Project will result in a certain amount of forest clearing, but the magnitudes of impact are expected to be low (Table 4-2).

Table 4-2. Concurrence among measurement endpoints for raptors at the Wild Meadows Wind Project

Increasing Evidence of Risk	Evidence of Impact?/ Magnitude?	Weighting Factors				
		Low	**Low/ Medium**	**Medium**	**Medium/ High**	**High**
	Yes / High					
	Yes / Moderate					
	Yes / Low		**1a, 2a**	**2b**	**1b**	
	No					
	Undetermined					
	Increasing Confidence or Weight					
1a	Literature Review (Potential collision mortality of raptors)					
1b	Raptor Migration and Regional Bird Surveys (Potential collision mortality of raptors)					
2a	Literature Review (Indirect impacts to raptors)					
2b	Habitat Characterization (Indirect impacts to raptors)					

4.2 NOCTURNALLY MIGRATING PASSERINES

4.2.1 Information Summary

Many small birds, including rails, shorebirds, flycatchers, sparrows, orioles, thrushes, warblers, vireos, as well as many waterfowl, migrate nocturnally (Zimmerman 1998). The majority of nocturnal migrants in eastern North America are passerines including warblers, sparrows, thrushes, grosbeaks, and tanagers (Farnsworth *et al.* 2004). Many species migrate diurnally including waterfowl, loons, gulls, raptors, swallows, nighthawks, and swifts. Some birds, including wading birds, migrate both day and night (Zimmerman 1998).

The peak in bird density in the sky at night generally occurs before midnight (Farnsworth *et al.* 2004, Zimmerman 1998) and gradually decreases until sunrise (Zimmerman 1998). Most migrants fly at high altitudes, possibly to take advantage of favorable following winds, to prevent overheating, to navigate over landscape features, to fly over fog or clouds, or to avoid physical barriers (Zimmerman 1998). Some birds, including waterfowl and shorebirds, are known to fly at elevations greater than 6,000 m (20,000’) (Zimmerman 1998, Sibley 2001). Whereas previous studies suggested that most small birds migrate at altitudes between 150 and 300 m (492 and 984’) (Zimmerman 1998) and that the majority of passerines migrate at altitudes between 90 and 610 m (295 and 2000’) (Kerlinger 1995 cited in NRC 2007), numerous radar surveys conducted in recent years at proposed wind projects suggest that flight height of nocturnally migrating passerines is relatively constant, and takes place at high altitudes, with mean values for flight heights generally ranging between 300 m and 600 m (985 and 1969’) above ground level for entire survey periods (see Appendix B, Table 11 and Appendix B, Table

12). Recent radar studies also indicate that approximately 10 percent of migrants fly below 125 m, the maximum height of most modern wind turbines (NRC 2007). Long-distance migrants typically migrate at higher elevations than short-distance migrants. Some shorebird and waterfowl species make non-stop flights between the breeding and wintering grounds, while more short distant migrants make stop-overs at locations along their migration route to rest and forage. Passerines typically reach peak altitudes just before midnight, and gradually decrease in altitude until sunrise.

Most species travel along 'broad fronts' during migration in the region. The width of many species' migration corridors may be similar to the width of their breeding range (typically over 3219 km [2000 mi] east to west) (Zimmerman 1998). A study in Europe suggests that species with a broad east-to-west breeding range will cross all topographical features during migration including lakes, river valleys, and mountains (NRC 2007). Many waterfowl follow interior migration paths across North America as they travel to their wintering grounds along the Atlantic Coast from their breeding grounds in Canada. Some waterfowl travel southeast from central Canada, crossing the Great Lakes, New York, and Pennsylvania before reaching their coastal destinations. Certain species travel to and from breeding grounds along elliptical or circular migration routes, potentially to take advantage of seasonal wind conditions (Zimmerman 1998). For example, some species may occur along the eastern coast in the fall and then within the interior during migration in the spring.

During the fall, the largest movements of migrants usually occur following the passage of a cold front. Low pressure systems in the spring are associated with large migration movements (Zimmerman 1998). Species will migrate in overcast conditions that are characterized by favorable tailwinds. When weather conditions result in lower flight altitudes, birds may be at increased risk of collision with man-made structures (NRC 2007). Birds will continue migration movements in less favorable winds and increased cloud cover with precipitation; however, storm conditions will result in 'fall outs' where birds are forced to wait out adverse weather at stop-over locations. Although birds will still migrate in sub-optimal weather conditions the magnitude of migration is generally lower during these periods than during optimal migration conditions.

4.2.2 Potential Collision Mortality of Nocturnally Migrating Passerines (Assessment Endpoint 3)

4.2.2.1 Literature Review (Measurement endpoint 3a)

Rates of avian collision mortality at existing wind facilities in the eastern U.S. has been documented to range from 0 (Searsburg, Vermont) to approximately 13 (Sheffield, Vermont) bird fatalities per turbine per year (Appendix B, Table 10). Although avian collision mortality can occur during both the breeding and migration seasons, patterns in avian collision mortality at tall towers, buildings, wind turbines and other structures suggest that the majority of fatalities occur during the spring and fall migration period (NRC 2007). Limited data suggests that roughly half the fatalities at existing wind facilities represent migrant species, while the other half represents resident species (NRC 2007).

In New England specifically, avian mortality rates have been generally similar with a median of 2.74 birds/turbine/study period or study year (b/t/sp or b/t/yr), with most estimates below 4 birds per turbine per study period or study year, with the exception of Record Hill, Maine and Sheffield, Vermont (refer to Appendix B, Table 10 for references): (Note that the field methods and statistical analysis varied among projects so direct comparisons among sites should be done with caution.)

- Searsburg, Vermont, 1997, 0 b/t/yr (no birds found during searches);
- MMA turbine, Massachusetts, 2006, 2.15 b/t/yr;
- Mars Hill, Maine, 2007, 0.44 to 2.5 b/t/yr;
- Mars Hill, Maine, 2008, 2.4 to 2.65 b/t/yr;
- Lempster, New Hampshire, 2009, spring: 0.80 b/t/sp and fall: 5.95 b/t/sp;
- Lempster, New Hampshire, 2010, spring: 1.16 b/t/sp and fall: 4.12 b/t/sp;
- Stetson Mountain I, Maine, 2009, 4.03 b/t/yr;
- Stetson Mountain II, 2010, 2.14 b/t/yr;
- Stetson Mountain I, 2011, 1.77 b/t/yr;
- Stetson Mountain II, 2012, 2.83 b/t/yr;
- Kibby, Maine, 2011, spring: 0.72 b/t/sp and fall: 0.29 b/t/sp;
- Rollins, Maine, 2012, 2.94 b/t/yr;
- Record Hill, Maine, 2012, 8.46 b/t/yr;
- Sheffield, Vermont, 2012, 13.17 b/t/yr; and
- Granite Reliable, New Hampshire, 2012, 2.0-2.8 b/t/yr.

The majority of carcasses found at existing wind facilities in the U.S. have been those of passerines (78%), while 5.3 percent of carcasses have been waterbirds, 4 percent have been fowl-like birds, 3.3 percent have been starling-pigeon-rock dove species, 2.7 percent have been diurnal raptors, 0.7 percent have been shorebirds, and 0.5 percent have been owls (NRC 2007). Results from the 45 studies at 31 operational projects in the eastern U.S. are consistent with the NRC's findings: passerines represented 77 percent of documented avian fatalities, followed by game birds (5%), raptor (5%), waterfowl (2%), shorebird (2%), and seabird (1%); other bird groups such as owls or wading birds represented one or less individuals recovered (refer to Appendix B, Table 10 for references). The data suggest that it may be the abundance of bird species that is associated with increased risk of collision; passerines are the most abundant terrestrial bird group and also represent the group with the highest observed fatality rate (NRC 2007).

Emerging evidence suggests that certain species of passerines are more susceptible to collision than others. The three species of passerine (identifiable to species) most commonly discovered during fatality searches at wind facilities in the eastern U.S. include red-eyed vireo (17%), golden-crowned kinglet (13%), and magnolia warbler (6%) (refer to Appendix B, Table 10 for references). Abundance appears to be a significant factor in species' risk of collision as each of these species is regionally abundant: the Partner's in Flight estimates of the North American populations of red-eyed vireo, golden-crowned kinglet, and magnolia warbler are 130 million, 100 million, and 40 million, respectively (http://rmbo.org/pifpopestimates/Database.aspx).

Flight behavior is also believed to be associated with rates of avian collision mortality. Species that migrate at higher altitudes or avoid migrating during inclement weather would be at decreased risk of collision. Birds such as black-capped chickadee (*Poecile atricapillus*) that migrate diurnally are also at decreased risk of collision. Similarly, species such as Canada goose (*Branta canadensis*) migrate at heights of 300 to 1000 m (984.3 to 3280.8'). Although this species exhibits flocking behavior, which could suggest an increased risk of collision, collisions of these birds with man-made structures are rare and not considered a concern for the species (Mowbray *et al*. 2002). Conversely, birds taking off at dusk or landing at dawn, or birds traveling in low cloud or fog conditions are likely at the greatest risk of collision.

Although artificial lighting has been thought to influence rates of bird collision at guyed communication towers, buildings, and other tall structures, the blinking Federal Avian Administration (FAA) lights typically installed on wind turbines do not appear to influence rates of collision (NRC 2007; Kerlinger et al. 2010). Jain *et al*. found no significant correlation between mortality rates of nocturnally migrating birds at lit versus unlit turbines at Maple Ridge, NY (Jain *et al.* 2008), and this lack of correlation has been documented at other operational wind facilities (NRC 2007). Kerns and Kerlinger (2004) documented no differences in rates of collision between lit and unlit turbines at the Mountaineer facility in West Virginia. The largest single mortality event documented in their study (33 passerines in one night) was thought to be due to a combination of foggy conditions and bright sodium vapor lighting at a substation within the facility, and not related to the FAA-required lighting on the turbines themselves (NRC 2007). In a review of data from 30 wind farms in North America, Kerlinger et al. (2010) found no significant difference between fatality rates at turbines with flashing red lights and turbines without lighting. Further, large mortality events (defined as >3 birds killed at one turbine in one night) were rare, comprising less than 0.02% of turbine searches. The four events documented in the data set were not due to turbine lighting (Kerlinger et al. 2010).

A recent large collision event documented at a school on Backbone Mountain, near the Mountaineer wind facility in West Virginia further suggested the potential for bright lighting, combined with foggy conditions, to result in high collision mortality of nocturnal migrants. On the morning of September 29, 494 songbirds, many of them warblers, collided with windows of the school during a relatively short period of time before and after sunrise (Christy Johnson-Hughes, WV USFWS, personal communication). This unprecedented mortality event was thought to be related to recent installation of bright lighting surrounding the school, which presumably attracted large numbers of birds, many of which collided with the building. More recently, a large mortality event occurred at the substation at the Laurel Mountain wind farm in West Virginia. On the morning of October 3, 2011 a large number of bird carcasses were observed at the substation. After completing searches between October 3 and 18, a total of 484 carcasses (mostly songbirds) were recovered at the substation. Several nearby wind turbines were searched on October 3 and no carcasses were found. The substation had 5 high pressure sodium lamps on utility poles lit during the night and weather over the weekend of October 1 and 2 was inclement, with a low cloud ceiling, thick fog, cold temperatures and high winds (Stantec 2011d). The documentation of isolated, large scale mortality events such as these suggest that nocturnal migrants are susceptible to collision on an episodic basis rather than a continuous, predictable level, with factors such as lighting, weather conditions, and seasonal timing playing important roles in determining when collision events occur.

While available literature on avian collision at wind farms is limited, it has recently been increasing due to an increase in projects available for study. Because of this increase certain predictions can be made about patterns of collision mortality of nocturnally migrating passerines at the Wild Meadows Wind Farm. Appendix C, Table 1 discusses the species that are at increased risk of collision impact during the migration period, based on their behavior and abundance or due to relatively high mortality rates at existing facilities. Although the species included in the list are not the only species that may experience collision mortality at the Wild

Meadows Wind Farm, available data suggest that these species could be at increased risk of collision either because the species have experienced high mortality at existing facilities or because they are species of conservation concern that are known to occur in and also migrate through the region. The information in the table is based on the most recent data from existing wind farms in the east, population estimates and trends, and known migration collisions with man-made structures.

The majority of avian fatalities at existing wind farms appear to be of nocturnally migrating songbirds. The factors that influence increased risk of collision appear to be a combination of overall abundance, weather, and species specific flight behaviors. Mortality associated with collisions with modern wind turbine models in the U.S. have not been known to result in a significant population level impact to any one species, mainly because the species with relatively high collision mortality are regionally abundant. Collision mortality at the Project is expected to be within the range of mortality observed at existing facilities on forested ridges in the northeast. The species composition of birds expected to be involved in collisions at the Project are expected to be similar to those found during turbine searches at existing wind farms in the eastern U.S. As species frequently involved in collisions are regionally abundant, a population level impact for any single species is not anticipated to result from collision mortality during migration.

In the Groton Phase I Avian Risk Assessment, Kerlinger and Guarnaccia (2008) indicated that the level of mortality for nocturnal migrants was not expected to be biologically significant at that Project because the populations of species that have been involved with collisions at existing wind farms in the east are stable, and avian fatalities are expected to be similar in numbers and species composition to those observed at existing facilities in the east. The preliminary results of 2013 fatality searches at Groton indicate low levels of fatality (however, a mortality estimate was not available at the time of this assessment); out of 23 total bird fatalities, the species commonly found included golden-crowned kinglet (n=4), red-eyed vireo (n=3), and unidentified thrush (n=3) (West 2013, preliminary data). The field surveys for the Lempster and Granite Reliable Projects in New Hampshire also did not indicate that there would be signigicant impacts to nocturnal migrant passerines (Appendix B Table 11); and neither of these projects observed unusually high levels of fatality for any one species (Tidhar et al. 2010 and 2011, Curry and Kerlinger 2013).

4.2.2.2 Nocturnal Marine Radar Surveys (Assessment Endpoint 3b)

Nocturnal marine radar surveys were conducted for 35 nights in fall 2009 (Table 2-1) from a clearing on Melvin Mountain. While this location is no longer in the current Project area, results from this proximal location are representative of the Project area in terms of passage rates and flight heights because the topography and elevation of these locations are similar. Mean passage rate was 980 ± 39 targets per kilometer per hour (t/km/hr). Mean flight height was 362 m ± 1 m (1,186 ± 3') and the seasonal average of percentages of targets flying below the proposed rotor zone was 19 percent (Stantec 2011a). Nocturnal marine radar surveys were conducted for 33 nights in spring 2010 (Table 2-1). Mean passage rate was 467 ± 24 t/km/hr. Mean flight height was 387 m ± 2 m (1,270 ± 5') and the seasonal average of percentages of targets flying below the proposed rotor zone was 19 percent (Stantec 2011b). The Wild Meadows mean passage rate documented in fall 2009 is higher than those recorded for other publicly available studies in the Northeast; however the mean flight height and average percent below turbine height were within the range of results recorded for other publicly available studies in the Northeast (Appendix B, Table 11). Results from the spring 2010 radar survey are within the range of results recorded for other publicly available studies in the Northeast (Appendix B, Table 12).

Although not conducted during the same nights and year, the results documented at the Project can be compared to the results of the pre-construction radar surveys conducted at other proposed and operating facilities in New Hampshire and New England (Table 4-3). Passage rates are often highly variable between sites, and comparison between sites must be done with caution. Differences in passage rates could be due, in large part, to differences in radar view between sites. In particular, the topography, local landscape conditions, and vegetation surrounding a radar survey location can dramatically influence the ability of any radar unit to detect targets and can affect the subsequent calculation of passage rate. These differences should be recognized as one of the more significant limiting factors in making direct site-to-site comparisons in passage rates.

In addition to differences in radar views between sites, year-to-year variation in species population size and weather conditions may also contribute to variation in passage rate. Fall passage rates are usually larger than rates observed in the spring. Because radar surveys are conducted from the same location during spring and fall, differences in passage rates between spring and fall surveys represent variability in nocturnal migration between seasons rather than differences in site characteristics. Typically, the fall songbird migration would be expected to be heavier, due to the fact that the migratory flock includes young of the year as well as adults returning from their breeding range. This was also observed at the Project. The season mean fall (980 t/km/hr) passage rate was more than twice that of the spring passage rate (467 t/km/hr).

A more significant trend observed during both spring and fall surveys is a considerable night to night variation in passage rates, indicating that nocturnal migration is episodic, likely due to regional and local weather patterns, wind speed and direction, and other factors. Nightly variation in the magnitude and flight characteristics of nocturnal migrants is not uncommon and is often attributed to weather patterns, such as cold fronts and winds aloft (Hassler *et al.* 1963, Gauthreaux and Able 1970, Richardson 1972, Able 1973, Bingman *et al*. 1982, Gauthreaux 1991). Weather conditions during each of the seasonal surveys which occurred in different years may have varied enough to cause different patterns in nocturnal migration.

Nevertheless, it can be useful to put radar survey results in context with other studies while remaining mindful of potential comparison pitfalls. The passage rate from fall surveys at Wild Meadows was higher than documented elsewhere in New Hampshire and New England. However, spring passage rates were within the range documented elsewhere in the state. Nightly and hourly passage rates varied widely (see Appendix B, Table 11 and Appendix B, Table 12), similar to other studies conducted elsewhere in the state.

Comparison of flight altitude between survey sites is generally less influenced by site characteristics, as the main portion of the radar beam is directed skyward and the potential effects of surrounding vegetation on the radar's view can be more easily controlled. The emerging body of studies characterizing nocturnal migration shows a relatively consistent pattern in flight altitude, with most targets appearing to fly at altitudes of several hundred meters or more above the level of the radar unit. This pattern was observed at Wild Meadows, as well as at other proposed and operational wind facilities in New Hampshire (Table 4-3). Unlike passage rates, flight heights were more consistent between survey nights and between fall and spring surveys. A difference of only 47 meters (m) was observed between the season mean flight height during spring than fall at the Project. The bulk of detections were recorded at heights of between 200 m and 500 m above ground level during both spring and fall radar surveys. This is quite typical of radar surveys, and is a consistent pattern observed across most radar surveys.

Table 4-3. Comparison of pre-construction radar survey results among NH and New England projects.

Project (number of survey nights)	Distance from Wild Meadows (direction)	Passage Rate (t/km/hr)		Flight Height (m)		Percent below max turbine height	
		Spring (year)	Fall (year)	Spring (year)	Fall (year)	Spring (year)	Fall (year)
Wild Meadows (n = 35 [fall], 33 [spring])		467 ± 24 (2010)	980 ± 39 (2009)	291 ± 7 (2010)	338 ± 5 (2009)	19% (2010)	19% (2009)
Lempster (n = 32 [fall]; 30 [spring])	30 miles (SSW)	542 ± 61 (2007)	602 ± 65 (2006)	358 ± 27 (2007)	387 ± 14 (2006)	18% (2007)	8% (2006)
Groton (n = 45)	12 miles (NNE)	234 ± 20 (2008)	470 ± 17 (2008)	321 ± 16 (2008)	342 ± 16 (2008)	12% (2008)	13% (2008)
Granite Reliable (n = 30)	85 miles (NNE)	342 ± 18 (2007)	469 ± 46 (2006)	332 ± 20 (2007)	455 ± 15 (2006)	14% (2007)	1% (2006)
Average values for ME, NH, VT projects (n = 24 projects)		360	441	341	372	19%	14%

Comparing pre-construction results to post-construction mortality rates is perhaps more illustrative than comparing pre-construction radar results among sites. Post-construction surveys were conducted at the Lempster Wind Project during the fall and spring of 2009 and 2010 (Tidhar et al. 2010, Tidhar et al. 2011). Mortality rates for nocturnally migrating passerines for both years were within the range of results of other mortality monitoring surveys conducted at existing windfarms in the eastern U.S. (Appendix B, Table 16). Notably, pre-construction passage rates documented at Lempster, NH in spring and fall (see Table 4-3) were on the high end of the range of results recorded for other publicly available studies in the Northeast (Appendix B, Table 11 and Appendix B, Table 12); however, post-construction survey results suggest low to moderate levels of collision mortality for birds (Spring: 0.8 birds/turbine [2009] to 1.16 birds/turbine [2010]; Fall: 4.12 birds/turbine [2010] to 5.95 birds/turbine [2009]). The pre-construction passage rates observed at Granite Reliable and Groton were within the range of other studies in the region (though lower than Lempster and Wild Meadows). These projects observed low numbers of bird fatalities during initial post-construction monitoring: there were 23 birds found at Groton in 2013 (no mortality estimate available at the time of this assessment;

West 2013, preliminary results); and there was 1 bird found during searches in 2012, and a mortality estimate of 2.0-2.8 birds/turbine/study period at Granite Reliable.

This demonstrates the challenge with correlating pre-construction radar survey results with post construction fatalities. Passage rates are highly variable among sites, and high passage rates do not correlate with high mortality rates of nocturnal migrants. In a review of 19 wind facilities in Maine, New Hampshire, Vermont, New York, and Pennsylvania which all have both pre-construction survey results and post-construction bird mortality estimates, there was no relationship between passage rate and bird mortality rate (Figure 4-3). Most facilities had multiple seasons and years of data collection, resulting in 27 pairs of passage rates and mortality rates among the 13 facilities. Passage rates ranged from 91 t/km/hr to 643 t/km/hr; estimated mortality rates ranged from 0.44 bird per turbine per study period (b/t/sp) to 13.17 b/t/sp. Notably, the highest estimated mortality (13.17 b/t/sp) was documented at the Sheffield Wind Project in Vermont which also had the lowest passage rate (91 t/km/hr). Further, pre-construction radar surveys at the Sheffield project documented the lowest percent of targets below turbine height (125 m), 1%. Conversely, the lowest estimated mortality rate (0.44 b/t/sp) was observed at Mars Hill, Maine which had a much higher pre-construction radar passage rate (512 t/km/hr). It is therefore likely that pre-construction passage rates do not necessarily predict potential bird mortality at a site.

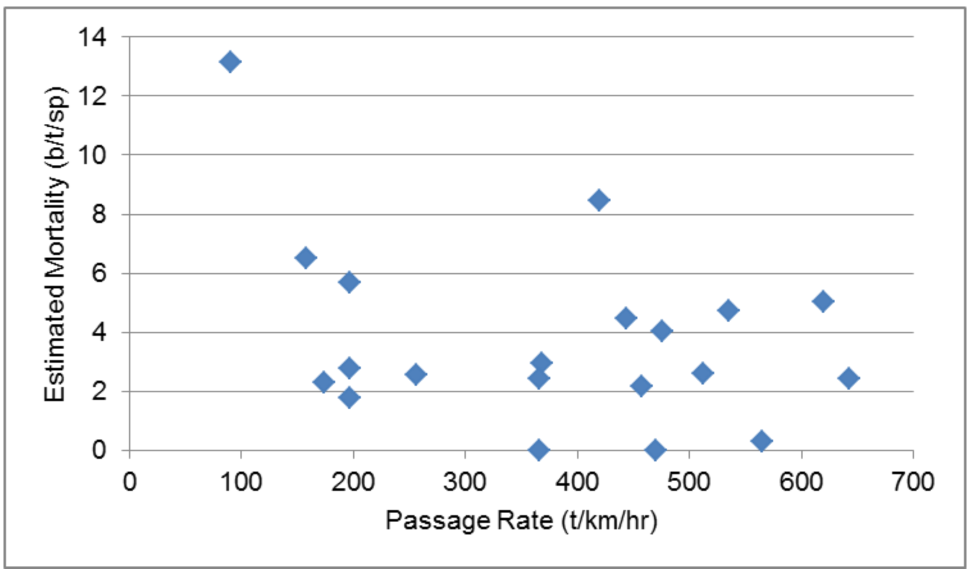

Figure 4-3. Pre-construction passage rates (targets per kilometer per hour) and post-construction estimated bird mortality (birds per turbine per study period) at 19 wind facilities in Maine, New Hampshire, New York, Vermont, and Pennsylvania. See Appendix B Table 13 for study details and citations.

Overall, results of radar surveys suggest that migration patterns of nocturnal migrants differ between fall and spring, and that flight height is generally consistent. While nocturnal migrants were observed to pass through the air space in the vicinity of the Wild Meadows Project, the majority of targets were recorded as flying above the height of the proposed wind turbines. A relatively small percentage of targets were observed to occur below turbine height on most sampled nights. Therefore, while a portion of nocturnal migrants passing over the area are expected to occur within the rotor zone of proposed wind turbines, this measurement endpoint suggests that the magnitude of collision mortality of nocturnal migrants is expected to be moderate (Table 4-4).

Table 4-4. Evaluation of risk of impacts to nocturnally migrating passerines at the Wild Meadows Wind Project.

Assessment Endpoint		Measurement Endpoints		WOE Score	Risk of Impact	Magnitude of Impact	Rationale
3	Potential collision mortality of nocturnally migrating passerines	3a	Literature Review	Low/ Medium	Yes	Low	While impacts to nocturnally migrating passerines have been documented at most wind energy facilities, rates of collision appear to be low in the eastern U.S., particularly in New England.
		3b	On-site Radar Surveys	Medium	Yes	Moderate	Radar surveys documented moderate to high passage rates, but most targets were flying at heights above proposed turbine height. Further, there is little to no relationship between passage rate and collision rate.

4.2.3 Conclusions

Although nocturnally migrating passerines are expected to pass above the Project area during spring and fall migration periods, most of these individuals are expected to fly at consistently high altitudes above the height of the proposed turbines, as has been documented in the vast majority of recent radar surveys conducted at proposed wind facilities in the northeast. Literature review also suggested that, while impacts to nocturnally migrating passerines occur at most wind energy facilities, very small numbers of birds have collided with turbines relative to the large numbers of nocturnally migrating passerines. Mortality estimates for birds (which primarily consist of nocturnal migrant passerines) in New England are generally low. Birds species frequently involved in collisions have generally included regionally abundant species. Both measurement endpoints predicted the potential for collision mortality to occur, with literature review predicting a low magnitude of impact and the radar surveys conducted for the Project predicting a moderate magnitude of potential impact (Table 4-5).

Table 4-5. Concurrence among measurement endpoints for nocturnally migrating passerines at the Wild Meadows Wind Project

Increasing Evidence of Risk ↑	Evidence of Impact?/ Magnitude?	Weighting Factors				
		Low	**Low/ Medium**	**Medium**	**Medium/ High**	**High**
	Yes / High					
	Yes / Moderate			**3b**		
	Yes / Low		**3a**			
	No					
	Undetermined					
	Increasing Confidence or Weight →					
3a	Literature Review (Potential collision mortality of nocturnally migrating passerines)					
3b	Radar Surveys (Potential collision mortality of nocturnally migrating passeries)					

4.3 BREEDING BIRDS

This section characterizes the non-raptor breeding bird population. Information regarding raptors that may breed within the Project area is described in Sections 3.1 and 4.1.

4.3.1 Collision Mortality to Breeding Birds (Assessment Endpoint 4)

4.3.1.1 Literature Review (Measurement Endpoint 4a)

Literature review on the risk of collision mortality to breeding birds suggests that, while the majority of documented avian collisions are thought to occur during spring and fall migration periods, avian collision mortality can occur during the breeding season as well. Most mortality studies have not been able to accurately distinguish between resident and breeding bird fatalities. Limited data suggest that roughly half the fatalities at existing wind facilities in the U.S. represent migrant species, while the other half represents resident species (NRC 2007); however, it is expected this ratio would vary regionally based on the species present and their behaviors.

Factors that could influence the susceptibility of breeding birds to collision mortality would include abundance, foraging behavior, and other behaviors such as courtship displays. In the West and Midwest, the species most commonly found at existing facilities are those that are locally abundant: horned lark (*Eremophila alpestris*), vesper sparrow, and bobolink (*Dolichonyx oryzivorus*). However, these species also engage in courtship displays which may result in flights within the rotor zone of turbines (NRC 2007). Many species of songbirds, including wood warblers, engage in territorial or courtship chasing flights during the breeding season, which may also increase their risk of collision. Although many passerines are foliage gleaners or ground foragers and therefore are at decreased risk of collision while foraging, some species engage in insect or bird 'hawking' behaviors that may put them at increased risk of collision at certain times.

While abundance and certain flight behaviors may increase risk of collision to certain breeding bird species, other species apparently avoid turbines. Crows and ravens (*Corvus spp*.) are often seen flying at heights that would be within the rotor zone of wind turbines and are often present in large numbers, yet they are rarely found during fatality searches (NRC 2007). Similar to raptors, breeding birds can presumably avoid encountering turbines by seeing the blades or detecting the motion of spinning blades, or by acoustically detecting them (Dooling 2002). Avian turbine avoidance behaviors are presumably species specific and dependent on a range of environmental factors including visibility and auditory conditions. To some extent, resident birds are anticipated to habituate to the presence of turbines, as they have to other man-made structures such as bridges, buildings, and communication towers. Birds have been observed to become habituated to turbines and have been seen frequently flying between strings of non-operational turbines (Osborn *et al*. 1998).

Landscape features may also influence risk of collision mortality to breeding birds. Although there are currently no strong correlations demonstrated between habitat type and avian fatalities at wind farms, certain resources may influence bird abundance and susceptibility to collision including proximity to nesting habitat, prey abundance, water availability, or vegetation structure (NRC 2007). Habitat features that concentrate bird abundance or activity presumably increase risk of collision mortality. Certain facility design features may also influence the risk of collision. Modern turbine designs present less of an attraction to perching or nesting birds than the shorter, lattice-style towers used at older facilities.

While the majority of avian collisions at existing wind farms appear to be nocturnal migrant songbirds, collisions are also known to occur during the breeding season; however, it is expected this ratio would vary regionally based on the species present and their behaviors. For example, horned lark is a species that is often present year-round at western projects and is commonly found during fatality searches. At the Milford Wind Corridor in Utah, horned lark was the bird species most commonly found during fatality searches conducted from spring to fall from 2010-2013; its year-round presence and certain diurnal breeding behaviors were believed to put it at greater risk of collision (Stantec 2013). In contrast, at projects in the eastern U.S., it appears the majority of fatalities involve nocturnal migrant passerines and these fatalities predominantly occur during nocturnal migration, particularly during the fall. The factors that influence increased risk of collision appear to be a combination of overall abundance, as well as species specific flight behaviors. Mortality associated with collisions with modern wind turbine models in the US will not likely result in a population level impact to any one species, mainly because the species with relatively high collision mortality are locally abundant species. Overall, literature review (measurement endpoint 4a) indicates that impacts to breeding birds could occur, although the expected magnitude of these impacts is low (Table 4-6).

Table 4-6. Evaluation of risk of impacts to breeding birds at the Wild Meadows Wind Project.

Assessment Endpoint		Measurement Endpoints		Weighting Score	Risk of Impact	Magnitude of Impact	Rationale
4	Potential collision mortality of breeding birds	4a	Literature Review	Low/ Medium	Yes	Low	Collision mortality has been shown to occur for breeding birds, but at lower rates than during the migratory periods.
		4b	On-site and Regional Bird Surveys	Medium/High	Yes	Low	Besides the documentation of a great blue heron rookery located 1,525 m from the nearest proposed turbine, bird surveys documented typical abundances and species composition of breeding birds. Likelihood of collision is expected to vary by species depending on behavior and abundance.
5	Potential indirect impacts to breeding birds	5a	Literature Review	Low/ Medium	Yes	Low	Habitat removal and alteration will likely cause shifts in species abundance in the immediate vicinity of turbines and access roads. However, wind facilities generally result in a relatively small amount of clearing.
		5b	Habitat Characterization	Medium	Yes	Low	Habitats are currently relatively disturbed and fragmented. The small amount of clearing associated with the Project is expected to cause certain shifts in species distribution around turbines and access roads, but overall indirect impacts are expected to be minimal.

4.3.1.2 On-site and Regional Bird Surveys (Measurement Endpoint 4b)

On-site BBS, followed by BBA, USGS BBS, Audubon CBC, HMANA, and eBird data provide the most site-specific and representative data available on species composition and relative abundance of breeding birds in the Project area or in the vicinity of the Project area. While one spring season of on-site surveys does not necessarily enable identification of all species of breeding birds present, these on-site data combined with BBA, USGS BBS, Audubon CBC, HMANA, and eBird data collected in the vicinity of the Project over several years, provide an accurate representation of the local breeding bird community. (Note for the breeding bird survey, the locations of 10 of the 21 Project area survey points are considered to be outside of the Project area based on the 2013 turbine layout. However, results from these 21 original Project area points are still combined and are described as ‘inside the Project area’ for this report. Survey locations on Melvin Mountain that are now outside of the Project are representative of breeding birds that may occur within the current Project area due to the proximal location and the similarities between these locations and the Project area in terms of habitat, elevation, and topography.)

Including birds observed beyond 100 m from the observer and birds observed as flyovers, breeding bird surveys at the Project documented a total of 35 species and one unidentified passerine during point count surveys in the Project area. Four additional species were observed incidentally in or near the Project area between point counts. A total of 27 species were detected within the control points during point count surveys. Excluding incidental observations, there were 24 species in common between the Project area and the control area. Of the 42 total species documented on-site during the 2010 surveys, all are generally common and regionally abundant, and are generally representative of the habitats in which they were detected. Among the most common species were dark-eyed junco (*Junco hyemalis*), ovenbird (*Seiurus aurocapillus*), and chestnut-sided warbler (*Dendroica pensylvanica*).

The species composition between Project and control points was similar; however, species richness for the control points was lower. This may be a reflection of the relatively fewer points sampled for control points, or differences among habitat at control verses Project area points. Among the Project area habitats sampled, hardwood forest had the greatest number of detected individuals, the highest diversity of species, and the most even distribution of species across points sampled within this habitat. Among control points sampled, conifer forest had the greatest number of individuals detected, the highest diversity of species, and the most even distribution of species across points sampled within this habitat. All species observed, the number of individuals, relative abundance, and frequency of occurrence of species detected during the 2010 breeding bird surveys are available in the Spring 2010 Avian and Bat Survey Report (Stantec 2011b)

During summer 2011 mist netting surveys, Stantec biologists incidentally documented a great blue heron (*Ardea herodias*) rookery (Stantec 2012). The rookery was located at the wetland south of The Pinnacle. Seven nests were counted and adults and juveniles were present. The rookery is approximately 1,525 m (5,000’) south of the nearest proposed turbine located on The Pinnacle. Other than the great blue heron rookery, unusually large numbers of birds or unusually high species diversity were not documented during on-site surveys. Regional breeding bird surveys documented a greater diversity of species, as these surveys sampled additional lower elevation habitats. Regional surveys also provide multiple years of data, resulting in higher species richness.

There were no endangered or threatened species observed during on-site BBS surveys; however one state special concern species was observed, American kestrel (*Falco sparverius*), at one of the Project area survey points. Of the 64 breeding-bird species considered rare by NHFGD and NH PIF, 18 were documented in the Project area during on-site field surveys (either during the point count surveys, raptor surveys, or incidentally between point counts) (Appendix B, Table 7). Of the 64 species considered rare by the NHFGD and NH PIF, 41 were detected during the regional surveys (BBA, USGS BBS, Audubon CBC, HMANA, and eBird data). Again, the higher species diversity documented in regional surveys is primarily a result of the fact that regional surveys sampled a greater diversity of habitats, were conducted at lower elevations with generally milder conditions, and occurred over many years. Additional years of breeding bird surveys at the Project would likely document year-to-year shifts in species composition and abundance, and would likely add a small number of additional species each year, but would not be expected to document a breeding bird community significantly different from that characterized by the on-site surveys conducted in 2010.

According to the general understanding of interactions between breeding birds and wind turbines, species of breeding birds most susceptible to collision mortality at the Project would include those that are relatively abundant in the Project area, those with behaviors that would cause them to fly in the rotor zone of the proposed turbines, and those species that have been most commonly found at mortality studies conducted at other operational facilities. Results of on-site BBS and regional data sets regarding avian species composition and abundance suggest that the breeding bird population at the Project is relatively limited in comparison to the surrounding region, as a low diversity of habitats occurs within the ridgeline Project area, where conditions are generally harsher and presumably less suitable as nesting habitat than in the surrounding valleys and plateaus. Species richness within the Project area was considerably lower than that documented regionally.

While overall risk of collision mortality to breeding birds is expected to be low, certain species are likely to be at slightly higher risk than others, based on their relative abundance, behaviors, or mortality data from other wind facilities. Appendix C, Table 2 lists species that could be at increased risk of collision mortality at the Project during the breeding period based on these factors. The species included in the list are not the only species that may experience collision mortality during the breeding season at the Project; however, based on available information, these species are believed to be at increased risk of impact. Among these (but not limited to) are the ovenbird, rose-breasted grosbeak, red-eyed vireo, purple finch, and chestnut-sided warbler. The table also includes species of conservation concern that were documented in the Project area. Whereas most of these species were not present in the Project area in large numbers, they could suffer greater cumulative impacts due to their vulnerable populations even though these species would likely not constitute a large number of fatalities at the Project.

Overall, collision mortality of breeding birds at the Project is expected to be within the range of mortality observed at existing facilities in the east, although differentiation between mortality of breeding and non-breeding passerines is difficult (Appendix B, Table 10). Results of on-site and regional bird surveys (measurement endpoint 4b) suggest that, while impacts to breeding birds may occur, the magnitude of these impacts is expected to be low (Table 4-6). Moreover, the

Project area does not appear to support large numbers of any RTE bird species during the breeding season and impacts to these species are expected to be minimal. A population level impact for any single species is not anticipated to result from collision mortality during the breeding season.

4.3.2 Indirect Impacts (Assessment Endpoint 5)

4.3.2.1 Literature Review (Measurement Endpoint 5a)

In addition to direct impacts associated with collision mortality, development of wind facilities can result in indirect impacts associated with habitat loss or displacement of species. These types of impacts are potentially complex, involving shifts in species abundance, turbine avoidance, habitat use, and behavioral disruption. While wind facilities generally result in relatively small amounts of habitat loss, they create a considerable amount of edge habitat associated with turbine pad clearings, new roads, and transmission lines. There are limited data available addressing impacts to birds associated with habitat loss due to wind farm developments in the U.S., particularly in the eastern U.S., as the majority of studies have focused on the more direct impact of collision mortality.

The creation of edge habitat in previously forested areas may decrease the abundance of forest interior species while increasing the abundance of predatory species such as American crow (*Corvus brachyrhynchos)* or blue jay (*Cyanocitta cristata*), or brood parasitic species such as brown-headed cowbird (*Molothrus ater*). Additionally, increased human presence around nesting areas due to maintenance activities may decrease the reproductive success of some sensitive species. The level of habitat disturbance associated with the Project relates to the topography, the conditions of habitats present, the amount of existing roads or infrastructure, and the turbine layout (NRC 2007). Habitat disturbances would be species specific and would depend on the condition and availability of habitat prior to construction (NRC 2007). Species with specific habitat requirements or species of conservation concern would be at increased risk of impact due to habitat modifications. Forest dwelling species such as wood thrush (*Hylocichla mustelina*) or blue-headed vireo (*Vireo solitarius*) require extensive tracks of undisturbed forest for successful reproduction.

At wind farms, an estimate of the total area disturbed per turbine ranges from one to three acres (NRC 2007). However, impacts such as edge effect may extend as far as 100 to 340 m (330' to 1122') from the footprint of a turbine for some forest interior species (NRC 2007). Habitat loss due to the modification of habitat or displacement due to an edge effect or fragmentation may be long-term, whereas habitat loss due to displacement because of disturbances associated with construction may be temporary for some species (NRC 2007). The creation of forest edge habitat results in net loss of habitat for some forest dwelling species, while the same impact may increase the local population of species including brown thrasher (*Toxostoma rufum)*, Northern cardinal (*Cardinalis cardinalis*), Northern mockingbird (*Mimus polyglottos*), ruffed grouse (*Bonasa umbellus*), and wild turkey (*Meleagris gallopavo*) (NRC 2007). The decrease of forest canopy can improve habitat for shrub-nesting species such as eastern towhee (*Pipilo erythrophthalmus)*, indigo bunting (*Passerina cyanea)*, and song sparrow (*Melospiza melodia*). However, species such as ovenbird and blackburnian warbler may be impacted by the removal of stands of mature hardwood trees (NRC 2007). Historically, forest harvesting and other impacts have resulted in decreases in the populations of ovenbird, Kentucky warblers

(*Oporornis formosus*), and worm-eating warblers (*Helmitheros vermivorus*). In grassland settings, development may increase habitat for some species that nest on recently disturbed ground such as many species of sparrow (Johnson *et al*. 2000).

Some species have a greater tolerance than others for human activity and habitat modification in the vicinity of nesting areas. Although the majority of grassland nesting birds decreased their use adjacent to the turbines at the Buffalo Ridge facility, waterfowl observed continued use of the area. For example, a mallard nested 31 m (100') away from one of the turbines, suggesting some waterfowl become habituated to the presence of turbines (Osborn *et al*. 1998). Another wind power facility located in grassland habitat, however, did not produce large-scale displacement of grassland nesting birds. When Savannah Sparrow (*Passerculus sandwichensis*) and bobolink (*Dolichonyx oryzivorus*) densities at the Maple Ridge Wind Power Facility were compared to undeveloped nearby reference plots, it was found that nesting Savannah Sparrow populations suffered no displacement and nesting bobolink populations were minimally affected only at distances under 100 m from the turbine (Kerlinger and Dowdell 2008).

A study conducted at the Buffalo Ridge facility indicated that some species were more susceptible to displacement than others, including common yellowthroat (*Geothlypis trichas)* and grassland nesting species. Species were generally displaced from areas less than 100 m from the towers (NRC 2007, Johnson *et al*. 2000). However, analysis indicated that the turbines did not affect use of the area within 100 m from the towers for 65 percent of bird groups (waterfowl, shorebirds, doves, flycatchers, corvids, blackbirds, chickadees/nuthatches, tanagers/orioles, and thrushes) (Johnson *et al*. 2000).

Habitat impact and disturbance data is more limited for existing wind facilities in New England; however, there have been few studies at operational projects. Breeding bird surveys were conducted prior to construction, during construction, and after construction at the Green Mountain Power Corporation's Wind Power Facility in Searsburg, Vermont. The same diversity of species was detected during the three survey periods; however, the abundance and frequency of species at study sample sites changed over the three periods. Four of the most abundant species prior to construction, Swainson's thrush (*Catharus ustulatus*), white-throated sparrow (*Zonotrichia albicollis*), ovenbird, and red-eyed vireo, experienced declines in abundance during post-construction surveys. The decline was believed to be a result of the creation of forest edge as these birds are primarily forest interior species. Some species including blackpoll warbler, magnolia warbler, and dark-eyed junco remained unchanged. Yellow-rumped warbler (*Dendroica coronata*) and other edge species such as American robin and blue jay increased in abundance (Kerlinger 2002). At the Lempster Wind Project a common night hawk (*Chordeiles minor*) nest was found during pre-construction surveys in 2008 and was documented again at the project in the vicinity of operating turbines in July 2009, at the end of nesting season (Tidhar 2009).

Habitat modifications that occur during activities such as logging, residential development, and wind development have resulted in observable changes in the abundance of locally breeding birds. Impacts associated with habitat modification have resulted in the direct loss of habitat, as well as other indirect effects such as increased exposure to brood parasitism or nest predation. Habitat decline is a major factor associated with the declining populations of many avian species in the U.S. At wind facilities, turbines located in unique habitats that support sensitive species may present more of a risk of impact. Species with specific habitat requirements and species of conservation concern are more susceptible to impacts associated with habitat modification.

Overall, literature review on the likelihood of indirect impacts to breeding birds (measurement endpoint 5a) suggests that some indirect impacts will likely occur as the result of the Project, but that the magnitude of these impacts will be minimal, as the Project will result in a relatively small amount of clearing relative to the entire Project area and this area has experienced changes in habitat conditions due to timber harvesting activities in which the breeding bird population has likely become accustomed to (Table 4-6). These impacts are expected to consist primarily of shifts in distribution of species within the Project area which could also occur as the result of other types of impacts such as timber harvesting.

4.3.2.2 On-site General Habitat Characterization (Measurement Endpoint 5b)

As described in several sections of this document, habitats at the Project consist of a mid-successional northern hardwood – mixed conifer forest. On the majority of Project ridgelines, conifer species are mixed with the more dominant hardwood species or occur as small patches within the hardwood dominated landscape. Within the Project area, ridgeline heights are relatively uniform and topographic variation among peaks is 150 m (492‘). Throughout the Project area there are signs of timber harvesting activities as evidenced by skidder trails and clear cuts in various stages of regeneration.

Despite some anthropogenic impact, the forest is a largely intact, mid-successional ecosystem. The bird species breeding within the Project area are both interior species, such as black-throated green warblers (*Setophaga virens)*, and edge-associated species, such as chestnut-sided warbler. Impact on breeding bird species is likely to be complex and highly species-specific. While some species may be negatively affected by habitat changes or inter-species competition, others may benefit from these changes. Interior forest species, such as the ovenbird, that are more typically associated with contiguous forests, may shift their local distribution in response to construction of the Project, but are expected to remain within the Project area (Appendix C, Table 3). Because the Project area has been previously logged, the composition of the species present is not likely to change significantly after development.

Whereas indirect impacts of habitat loss and creation of edges will not necessarily diminish the overall abundance of breeding birds in the Project area, species composition of birds will likely shift in areas containing turbines, with forest interior species becoming less abundant and forest edge species becoming more common. Also, increased human activity may cause displacement of species such as blue-headed vireo and black-throated blue warbler (*Setophaga caerulescens*), which are more sensitive to human activity in the vicinity of nests and may experience decreased breeding success.

Based on field surveys and the habitat characterization (measurement endpoint 5b), indirect impacts are expected to result in species shifts from forest interior to forest edge species in the immediate Project footprint. However, the magnitude of these impacts is expected to be relatively minimal, considering the fact that much of the habitat in the Project area is currently fragmented by timber harvesting and existing road development, many of the species observed during field surveys are forest edge species or regenerating forest species rather than forest interior species, the footprint of development areas is relatively small (Table 4-6).

4.3.3 Conclusions

While collision mortality has been demonstrated for resident breeding birds, it is generally thought that collision mortality affects migrating birds to a greater extent based on the timing of fatalities during post-construction monitoring at existing wind facilities. Besides the documentation of a great blue heron rookery in the vicinity of the Project, on-site bird and habitat surveys did not reveal unique species assemblages, an unusually high species diversity, or unusually large numbers of birds. Based on comparison to regional surveys conducted in adjacent valleys with more diverse habitats occurring at lower elevations, breeding bird diversity is relatively low within the Project area. Generally, direct and indirect impacts to breeding birds at the Project are expected to be limited to a small amount of collision mortality and slight shifts in the distribution of breeding bird species within the Project area. Because many of the common species in the Project area are edge-associated species, typically inhabiting areas with human activity, many breeding bird species are expected to become habituated to the presence of the turbines, minimizing displacement and other indirect impacts. The four measurement endpoints used to assess potential direct and indirect impacts to breeding birds all predicted that, while impacts could occur, the magnitude of these impacts is expected to be low, indicating concurrence among the measurement endpoints (Table 4-7).

Table 4-7. Concurrence among measurement endpoints for breeding birds at the Wild Meadows Wind Project

Increasing Evidence of Risk ↑	Evidence of Impact?/ Magnitude?	Weighting Factors: Low	Low/ Medium	Medium	Medium/ High	High
	Yes / High					
	Yes / Moderate					
	Yes / Low		**4a, 5a**	**5b**	**4b**	
	No					
	Undetermined					
	Increasing Confidence or Weight →					

4a	Literature Review (Potential collision mortality of breeding birds)
4b	breeding birds)
5a	Literature Review (Indirect impacts to breeding birds)
5b	Habitat Characterization (Indirect impacts to breeding birds)

4.4 BATS

4.4.1 Characterization of the Bat Community

Eight species of bats occur in New Hampshire, based upon their normal geographical range. These are the little brown bat (*Myotis lucifugus*), northern long-eared bat, (*M. septentrionalis*), eastern small-footed bat (*M. leibii*), silver-haired bat (*Lasionycteris noctivagans*), tri-colored bat (*Perimyotis subflavus*), big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), and hoary bat (*L. cinereus*) (Whitaker and Hamilton, eds 1998). Of these, the small-footed bat is a state-listed endangered species and the northern long-eared bat was recently proposed for listing by the USFWS. Based on available habitat within the Project area, existing cleared areas, timber harvest roads, and other linear features provide potential foraging habitat for all the bat species mentioned.

4.4.2 Potential Collision Mortality of Bats (Assessment Endpoint 6)

4.4.2.1 Literature Review (Measurement Endpoints 6a)

Mortality of nine bat species has been documented at wind energy facilities in the eastern United States, with most fatalities occurring during what is generally considered the fall migration period (August to November; Arnett *et al*. 2008, Cryan 2003, Cryan and Brown 2007, Johnson *et al*. 2004). Species documented during turbine fatality searches in the east include little brown myotis, northern myotis, Indiana myotis, tri-colored bat, seminole, silver-haired, hoary, red, and big brown bat. With the exception of tri-colored bat, the species killed most frequently—hoary, red, and silver-haired bat—are long-distance migrants, traveling dramatically greater migration distances than other North American species (Cryan 2003, Cryan *et al.* 2004, Cryan and Brown 2007). Hoary, red, and silver-haired bats are closely related members of the *Lasiurus* and *Lasionycteris* genera, and it has been hypothesized that the migratory behavior of these species leads to their propensity to strike wind turbines (Cryan and Brown 2007; Kunz *et al*. 2007ab). Of the nine eastern species documented in post-construction mortality surveys, the Indiana bat and seminole bat do not occur in New Hampshire (BCI 2001).

Various hypotheses attempting to explain bat fatalities at wind energy sites are summarized in Kunz *et al*. 2007a. Several of these hypotheses propose attraction of bats to wind turbines through creation of linear habitat and/or potential roosts, habits and/or conditions favorable for foraging and high insect abundance, and attraction through auditory cues. Other hypotheses propose turbines cause electromagnetic disorientation, or that bats are unable to accurately determine turbine speed through echolocation. A recent study of bat activity around wind turbines documented bats foraging near and landing on turbines and on turbine monopoles, suggesting that bats are at risk during routine nightly behaviors, and that bat-turbine interactions are non-random (Horn *et al*. 2008). Thus, Horn *et al.* (2008) found evidence for attraction of bats to turbines, that bats actively forage around turbines, and that bat activity was positively correlated to insect activity. Although no relationships were found between bat activity and weather conditions at the Project, other studies where bat fatalities have been high, have found that bat collisions with wind turbines are greatest on relatively calm nights (wind speeds less than 4-6 m/s) (Arnett *et al*. 2008). This pattern is reinforced by pre-construction acoustic monitoring of bat activity at these projects, which has documented that bat activity was highest on nights with wind speeds of less than 5.4 m/s (Reynolds 2006) as well as the findings from recent curtailment studies. Arnett et al. (2013) synthesized information from operational mitigation studies conducted at 10 existing wind energy facilities in North America (2 projects in Canada, and 8 in the U.S.); they concluded that increasing cut-in speed between 1.5 and 3.0 m/s above turbine manufacturer's cut-in speeds (with modified cut-in speeds among projects generally between 4 and 6.5 m/s) yields substantial reductions in bat fatalities at projects with documented high bat fatality rates, with reductions in fatality rates as high as almost 80 percent. In New England where bat fatality has been low, it is not clear whether or not curtailment would lower bat fatalities given that bat fatalities have been shown to be low without curtailment.

There are several studies conducted recently in the Northeast that have sampled bat acoustic activity during the same timeframe as fatality surveys (Table 4-8). During these studies, detectors were deployed at various heights from ground level (2 m) to heights at, and approaching, nacelle height (30 - 80 m) (Table 4-8). When looking at data from all detector heights combined, there does not appear to be a strong relationship between bat mortality and acoustic activity among these sites in the Northeast. However, excluding those studies with just ground level detectors, and including only high detector (30 - 80 m) data, there does appear to be a correlation between bat acoustic activity and mortality (Figure 4-4 A and B).

Table 4-8. Results of surveys that compared acoustic bat activity rates to mortality rates during post-construction monitoring in the Northeast (in increasing order of mortality rate).

Project	Dates of acoustic survey	Bat mortality (bats/turbine/study period)[1]	No. detectors and height(s)	No. recorded calls	Bat activity (no. calls/detector night)	Source
Stetson Mountain I, Maine	10 July - 15 October, 2009	2.11	6 (2 @ nacelle, 4 @ ground: 4, 6, 2, 7 m)	9,997 (9,956 ground, 41 nacelle)	19.6 (28.5 ground, 0.26 nacelle)	Stantec Consulting. 2010. Stetson I Mountain Wind Project, Year 1 Post-Construction Monitoring Report, 2009. Prepared for First Wind Management, LLC.
Chateaugay, NY	17 April - 15 October, 2010	3.66	2 (40 and 75 m)	777	0.9	(NEES) North East Ecological Services. 2010. POST-CONSTRUCTION ACOUSTIC MONITORING Noble Chateaugay Windpark Franklin County, New York. Prepared for: Noble Environmental Power, LLC.
Steel Winds, NY	20 March - 5 November, 2012	5.83	4 (5 m)	28,678	74.3	Stantec Consulting. 2013. Steel Winds I and II Post-Construction Monitoring Report, 2012. Prepared for First Wind Management, LLC
Altona, NY	15 April - 15 October, 2010	6.51	2 (40 and 80 m)	567	1.6	(NEES) North East Ecological Services. 2010. POST-CONSTRUCTION ACOUSTIC MONITORING Noble Altona Windpark Franklin County, New York. Prepared for: Noble Environmental Power, LLC.
Record Hill, Maine	16 April - 23 October, 2012	6.78	4 (2, 10, 5, 5 m)	15,724	24.6	Stantec Consulting. 2012. Record Hill Wind Project Post-Construction Monitoring Report, 2012. Prepared for Record Hill Wind, LLC.
Ellenburg, NY	04 April - 31 October, 2009	8.01	2 (both 2 m)	3,746	1.5	(NEES) North East Ecological Services. 2010. POST-CONSTRUCTION ACOUSTIC MONITORING 2009 SAMPLING PERIOD Noble Ellenburg Windpark Clinton County, New York Prepared for: Noble Environmental Power, LLC.
Bliss, NY	3 April - 31 October, 2009	8.24	2 (40 and 75 m)	411	1.1	(NEES) North East Ecological Services. 2010. POST-CONSTRUCTION ACOUSTIC MONITORING 2009 SAMPLING PERIOD Noble Bliss Windpark Wyoming County, New York. Prepared for: Noble Environmental Power, LLC.
Clinton, NY	04 April - 31 October, 2009	9.72	2 (40 and 75 m)	340	0.9	(NEES) North East Ecological Services. 2010. POST-CONSTRUCTION ACOUSTIC MONITORING 2009 SAMPLING PERIOD Noble Clinton Windpark Clinton County, New York. Prepared for: Noble Environmental Power, LLC.
Howard, NY	15 April and 15 October, 2012	20.09	3 (2 @ nacelle/80 m, 1 @ ground)	4,738 (3,896 ground, 842 nacelle)	11.52 (28.8 ground, 2.88 nacelle)	West. 2013. 2012 Post-Construction Monitoring Studies for the Howard Wind Projgect Steuben County, New York. Prepared for Howard Wind, LLC.
Wethersfield, NY	15 April - 15 October, 2010	24.45	2 (30 and 60 m)	1,086	3.2	(NEES) North East Ecological Services. 2010. POST-CONSTRUCTION ACOUSTIC MONITORING Noble Wethersfield Windpark Wyoming County, New York Prepared for: Noble Environmental Power, LLC.
Cohocton, NY	21 April - 23 October, 2010	25.62	3 (2, 2.5 , 40 m)	46,293 (40 m only: 373)	106.7 (40 m only: 2.6)	Stantec Consulting. 2011. Cohocton and Dutch Hill Wind FarmsYear 2 Post-Construction Monitoring Report, 2010 for the Cohocton and Dutch Hill Wind Farms In Cohocton, New York. Prepared for Canandaigua Power Partners, LLC and Canandaigua Power Partners II, LLC.

1 If range of mortality estimates reported, highest estimate included here.

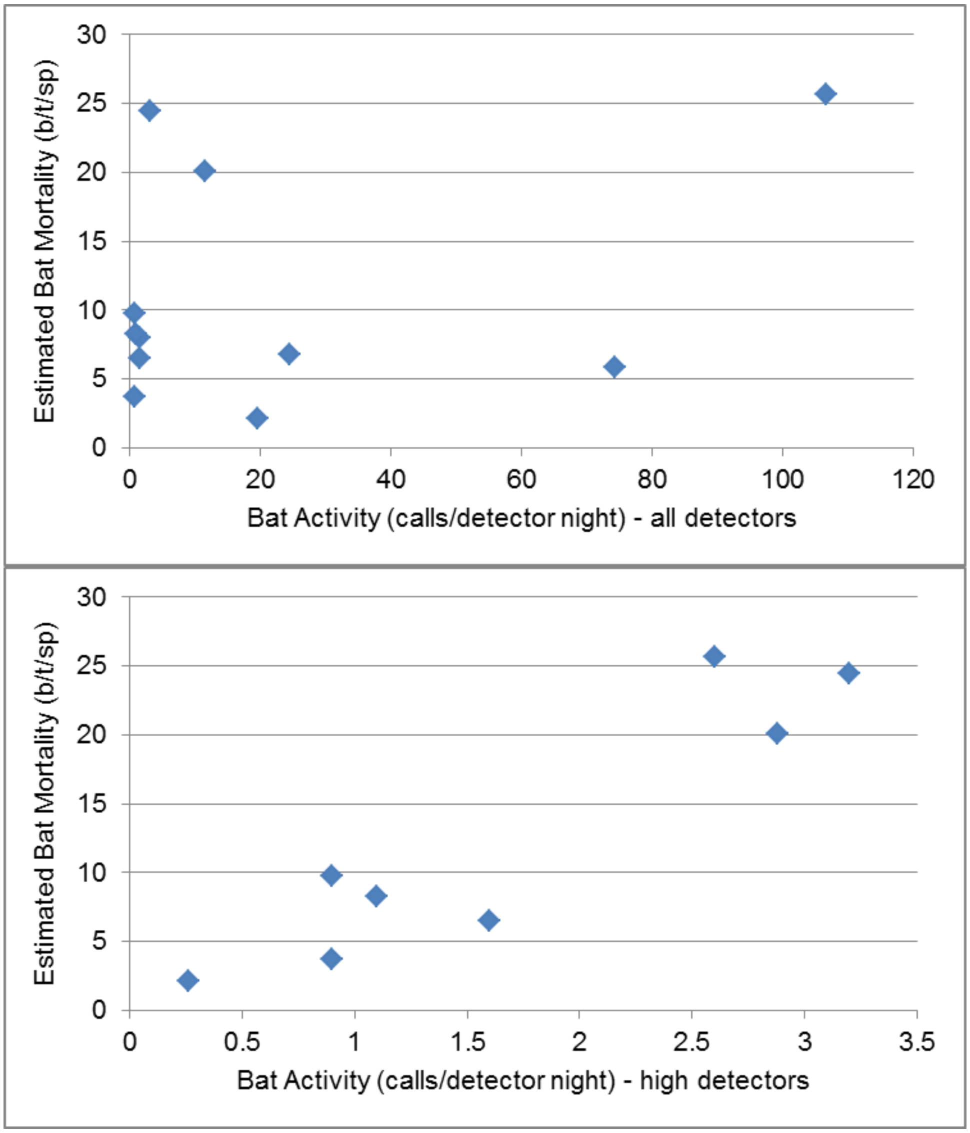

Figure 4-4. Results of surveys that compared acoustic bat activity rates to mortality rates during post-construction monitoring in the Northeast: A (top) all detectors heights, and B (bottom) only high detectors (30-80 m).

When comparing these survey results, it is important to consider that calls reported here are not broken down by species; therefore, acoustic calls may have been from different species than those documented in mortality surveys. Baerwald and Barclay (2009) examined acoustic activity of migratory species (red bat, hoary bat, silver-haired bat) at proposed and existing wind facilities across Alberta, Canada, and compared the results to post-construction mortality surveys. Only 31 percent of the variation in fatality rates at tall turbines (> 65 m) could be predicted by migratory bat acoustic activity at 30 m. (Note that Baerwald and Barclay [2009] compared migratory bat activity to mortality of all species.) There was no relationship between acoustic activity at ground-level and mortality (Baerwald and Barclay 2009). To date, no studies have shown a clear association between activity and fatality rates with enough power to predict mortality rates.

Mortality rates have been highest at wind developments along forested ridges in eastern U.S., particularly in the Mid-Atlantic and Appalachian states, with some of the highest estimated mortality occurring at the Mountaineer, WV development (47.5 bats per turbine per year [b/t/yr] in 2003 and 37.7 b/t/yr in 2004) and the Buffalo Mountain, TN development (20.8 b/t/yr from 2000 to 2003, and 63.9 b/t/yr in 2005) (Appendix B, Table 16). Post-construction surveys nearer to this Project area, and potentially more relevant, include recent studies conducted in New England. Bat mortality estimates have typically been below 7 bats per turbine per study year or study period, with a median mortality estimate of 2.11 bats/turbine/study year (refer to Appendix B, Table 10 for references): (Note that the field methods and statistical analysis varied among projects so direct comparisons among sites should be made with caution.)

- Searsburg, Vermont, 1997, 0 b/t/yr (no bats found during searches);
- MMA turbine, Massachusetts, 2006, 0 b/t/yr (no bats found during searches);
- Mars Hill, Maine, 2007, 0.43 to 4.4 b/t/yr;
- Mars Hill, Maine, 2008, 0.17 to 0.68 b/t/yr;
- Lempster, New Hampshire, 2009, spring: 0.58 b/t/sp and fall: 5.51 b/t/sp;
- Lempster, New Hampshire, 2010, spring: 0 b/t/sp and fall: 7.13 b/t/sp;
- Stetson Mountain I, Maine, 2009, 2.11 b/t/yr;
- Stetson Mountain II, 2010, 2.48 b/t/yr;
- Stetson Mountain I, 2011, 0.43 b/t/yr;
- Stetson Mountain II, 2012, 2.06 b/t/yr;
- Kibby, Maine, 2011, spring: 0 b/t/sp and fall: 0.37 b/t/sp;
- Rollins, Maine, 2012, 0.18 b/t/yr;
- Record Hill, Maine, 2012, 6.78 b/t/yr;
- Sheffield, Vermont, 2012, 14.65 b/t/yr, and
- Granite Reliable, New Hampshire, 2012, 2.6-3.0 b/t/yr.

The species of bats involved in collisions at these New England projects included silver-haired bat, hoary bat, eastern red bat, big brown bat, tricolored bat, and little brown bat (refer to Appendix B, Table 10 for references). The majority of bat fatalities at these New England facilities were documented from July to September (refer to Appendix B, Table 10 for references), consistent with the findings of other mortality studies conducted in the U.S. (Arnett *et al*. 2008).

Measurement endpoint 6a therefore indicates that the likelihood of collision mortality of individual bats as a result of the Project is relatively high (largely related to the behavior of long-distance migrants), and the magnitude of these impacts will be within the lower range of collision mortality observed at operational wind facilities located on forested ridgelines (Table 4-9). However, it is expected that collision mortality at the Project will be more similar to Projects on forested ridges in New England which have generally documented relatively low collision

Table 4-9. Evaluation of risk of impact to bats at the Wild Meadows Wind Project

Assessment Endpoint		Measurement Endpoints		WOE Score	Risk of Impact	Magnitude of Impact	Rationale
6	Potential collision mortality of bats	6a	Literature review	Low/ Medium	Yes	Moderate	Some bats are killed at most wind facilities in northeast, although there are variable rates of mortality at different sites and locations.
		6b	Acoustic and Mist Net Bat Surveys	Medium	Yes	Low	Presence of bat species indicates potential risk, which is expected to vary by species, although levels of acoustic activity recorded in met towers were relatively low.
7	Potential habitat loss or displacement of bats from the Project area	7a	Literature Review	Low/ Medium	Yes	Low	Removal of roost habitat is likely the greatest potential impact and is not generally outweighed by creation of additional foraging habitat associated with turbine pad clearings. However, wind facilities typically result in relatively small amount of forest clearing.
		7b	Habitat Characterization	Medium	Yes	Low	Forest clearing will affect a relatively small amount of habitat within the Project, although removal of roost trees may impact the quality of bat habitat.

rates compared to those seen in the Mid-Atlantic and Appalachian states. Given the small number of post-construction mortality studies that include detailed information on bats and the inability to relate literature to site-specific issues, this measurement endpoint is associated with a large degree of uncertainty.

While the majority of documented bat fatalities at wind facilities appear to occur during migration, bats are also at risk of collision during the summer. Exposure pathways may be different in the breeding season versus migratory periods, and could be more related to foraging patterns than migrating, flocking, swarming, or mating behavior. However, cumulative impacts of collision mortality during both migration periods and the summer breeding season are a particular concern for bats, as North American species tend to be relatively long-lived, and reproduce very slowly (Barclay and Harder 2003).

Also of concern to bat species in the Northeast is WNS, a disease that is responsible for the death of at least 5.5 million hibernating bats in the United States from 2006 to 2012 (USFWS 2012). Recent studies have determined that WNS is associated with a newly-described psychrophilic (cold-loving) fungus (*Geomyces destructans*) that grows on exposed tissues (i.e., noses, faces, ears, and/or wing membranes) of the majority of affected bats. The skin infection caused by *G. destructans* is thought to act as a chronic disturbance during hibernation (USGS 2010). Infected bats exhibit premature arousals, aberrant behavior, and premature loss of critical fat reserves which is thought to lead to starvation prior to spring emergence (Frick et al. 2010). It has been determined that *G. destructans* is the primary cause of death (Lorch et al. 2011). The fungus invades living tissue, causing cup-like epidermal erosions and ulcers (Meteyer et al. 2009, Puechmaille et al. 2010). These erosions and ulcers may in turn disrupt the many important physiological functions that wing membranes provide, such as water balance (Cryan et al. 2010). No other bacterial or viral agents have been detected through necropsies (CBD 2010).

At the end of the 2012-2013 hibernating season, WNS was confirmed in 22 states and five Canadian provinces (www.whitenosesyndrome.org). In Europe, *G. destructans* has been detected in southwestern France (Puechmaille et al. 2010), Switzerland, Hungary, and Germany (Wibbelt et al. 2010). However, no mass casualties have been detected among Europe's infected bats (Puechmaille et al. 2010, Wibbelt et al. 2010).

WNS is causing unprecedented mortality among at least 6 species of hibernating bats in North America (Frick et al. 2010): eastern small-footed bat, little brown bat, northern long-eared bat, tri-colored bat, big brown bat, and Indiana bat (USGS 2010). Other species affected include the cave myotis (*Myotis velifer*) and gray bat (*M. grisescens*). Until recently, Indiana bats were the only federally listed species known to be affected by WNS. However, in spring 2010 WNS was confirmed in 5 gray bats, also listed as federally endangered, in Shannon County, MO (BCI 2010). Now it is believed that all 25 species of bat in the US that rely on hibernation may potentially be affected by WNS (USGS 2010). An estimated 5.7 to 6.7 million bat fatalities have occurred since WNS was first recorded in 2007 (USFWS 2012); infected hibernacula have experienced annual population decreases ranging from 30% to 99%, with a mean of 73% throughout eastern North America (Frick et al. 2010). Total mortality averaged 95% at closely monitored WNS hibernaculum that had multiple years of infection in NY, MA, and VT in 2009 (A. Hicks, New York State Department of Environmental Conservation, personal communication, as cited by Turner and Reeder 2009). Winter surveys have shown significant impacts to bat populations in New Hampshire: between 2009 and 2010, there was a statewide bat population decline of 66% (NHFGD 2010).

WNS impacts different species at different rates. Winter Indiana bat census data from 2009-2010 in CT, MA, NY, and VT indicated that Indiana bat populations have experienced less severe declines as a result of WNS (i.e., 42% reduction), compared with declines in little brown bat and tri-colored bat populations (both estimated at 93% reduction), and northern long-eared bat populations (estimated at 99% reduction) (Langwig et al. 2010). The reductions reported by Frick et al (2010) and Langwig et al (2010) look at the impacts of WNS at the level of the hibernaculum, whereas impacts across entire states or regions could be different if individual hibernaculum are affected differently.

While data recorded in acoustic surveys do not equate to actual numbers of individuals on the landscape, the drastic population declines due to WNS have affected activity on the landscape. WNS has decreased the prevalence of *Myotis* species in acoustic surveys (Dzal et al. 2010, Brooks 2011, Ford et al. 2011). Since *Myotis* species represent such a small proportion of mortality from wind turbine collisions, and given their decline in activity on the landscape, it could be predicted that mortality at wind facilities will be further reduced for this group. On the other hand, each individual becomes more valuable as the population declines, so minimizing mortality at wind facilities remains important.

Although the onset of WNS has made population estimates extremely important for impacted species, very little was known about the population status and trends of most bat species prior to WNS impacts, and very little is known about species not impacted by WNS. Therefore, assessing the population-wide impacts of collision mortality can only be speculative at this point. Because susceptibility of collision mortality at wind facilities appears to differ by species and guild within the bat community, information regarding collision mortality of various species and guilds within the bat community is presented below.

4.4.2.1.1 Long-distance Migratory Bat Species

Hoary, red, and silver-haired bats, considered long-distance migratory bat species, appear to be at the greatest risk of collision with wind turbines (Arnett *et al*. 2008, Cryan 2003, Kunz *et al.* 2007a). This can be assumed given the number of recorded mortalities across the U.S., especially in the east (Kunz *et al*. 2007a). In New England specifically, long-distance migratory bats have accounted for 92 percent of documented fatalities (refer to Appendix B, Table 10 for references). Current data from mortality surveys to date show fatalities of these species occur at greater levels during fall migration, although mortalities of summer residents have also been observed (Kunz *et al*. 2007a). Fall migration patterns of hoary bats differs from spring migration patterns, with male and female hoary bats geographically separated until fall migration when mating occurs (Cryan 2003). This pattern led Cryan and Brown (2007) to postulate that migratory species flock at wind turbines during the fall, using these areas to locate potential mates and thus exposing them to higher mortality risk. Many other hypotheses regarding the increased mortality of long-distance migrants exist, and there are currently not enough data to explain why hoary, red, and silver-haired bats are killed in larger numbers than *Myotis* species and big brown bats. Although this trend has not yet been explained, no data suggests that different patterns should be expected for this Project.

4.4.2.1.2 Tri-colored bats

Tri-colored bats have also been found in large numbers during mortality surveys at wind facilities in North America, with more observed mortalities than silver-haired bats at some facilities (Kunz *et al*. 2007a). Interestingly, tri-colored bats are not known to migrate long distances between their summer and winter range (Fujita and Kunz 1984), setting them apart from the other three species frequently killed by wind turbines. Lack of long-distance migrations does not necessarily mean that fatalities are not linked to small-scale migration behavior, but it is unknown why small-scale movements would result in high mortality rates in tri-colored bats but not in *Myotis* species. Little research has been conducted on this species' foraging behavior, but it does appear that they are more frequently found over fields, water, and other open areas (Carter *et al*. 1999, van Zyll De Jong 1985). If tri-colored bats do prefer to forage in open areas or above the forest canopy this could potentially explain high mortality rates for this species. To-date, there has been one documented fatality of a tri-colored bat in New England (Lempster, NH), representing less than 1% of documented bat fatalities (refer to Appendix B, Table 10 for references).

4.4.2.1.3 *Myotis* species

Although *Myotis* species also migrate (Fenton and Barclay 1980, Kurta and Murray 2002), they do so at smaller scales than has been observed among the *Lasiurus* and *Lasionycteris* genera (Cryan 2003). Unlike red bats and hoary bats, North American *Myotis* species hibernate in caves (Whitaker and Hamilton, eds 1998), where copulation occurs prior to hibernation. Unlike the tree-roosting bats, *Myotis* species exhibit swarming behavior, in which they gather in large numbers outside hibernacula during the fall to find mates and copulate prior to entering hibernation. It is unknown whether the difference in migration and mating behavior between *Myotis* species and long-distance migrants is the cause for differing mortality rates, or if differences in mortality rates are the result of differences in other behaviors (i.e., foraging). Regardless, *Myotis* species are likely at lower levels of risk than hoary bats, red bats, and silver-haired bats based on post-construction surveys (Kunz *et al*. 2007a). *Myotis* species have comprised only 6.2 percent of documented bat fatalities across the U.S. (Kunz *et al*. 2007a). At New England projects, myotis have accounted for 4 percent of bats that were recovered during searches (refer to Appendix B, Table 10 for references).

To date, there have been at least two documented fatalities of eastern small-footed myotis' at wind projects in North America. Two fatalities occurred in Ontario, Canada: one at a site characterized by agricultural fields and forestedwoodlot habitats on the shoreline of Lake Erie; the other at a project located in agricultural fields near Lake Huron (Jacques Whitford-Stantec 2009 and James 2007). There is some uncertainty regarding the collision risk of this species at projects in New England, as to-date, none have been documented there. Regardless, large numbers of fatalities of this species are not expected at projects that occur within their range, because this species is uncommon and migrates very short distances (Best and Jennings 1997, Johnson and Gates 2008). These two factors suggest that exposure to wind turbines is likely limited across the species' range. However, the species' small size potentially makes finding carcasses during turbine searches more difficult than finding larger, more noticeable species. This species is therefore likely underrepresented during turbine searches, and probably moreso than other bat species.

Despite uncertainty, there are some ecological aspects of the eastern small-footed myotis' behavior which suggest the species might be at low risk from collision with wind turbines. Specifically, recent dietary studies of the eastern small-footed myotis suggest the species gleans prey off of vegetation (Johnson and Gates 2007, Moosman *et al*. 2007). If true, this gleaning behavior would result in individuals spending a substantial amount of time beneath the canopy, not exposing themselves to collision risk. However, there are currently no published data of foraging behavior to support or refute this hypothesis.

4.4.2.1.4 Big Brown Bats

Although big brown bats are abundant throughout the northeast, they have made up only 2.4 percent of total mortalities at wind developments across the U.S. (Kunz *et al*. 2007a), and 3 percent of bat fatalities at projects in New England (refer to Appendix B, Table 10 for references), indicating their risk is comparable to that of little brown and northern myotis and low relative to migratory tree bats and pipistrelles. Big brown bats are known for their ability to navigate using the earth's magnetic field (Holland *et al*. 2006). However, they are not known to migrate distances comparable to hoary, red, and silver-haired bats, although movements of up to 228 km have been recorded (Mumford 1958). Big brown bats are relatively large and are strong fliers, suggesting that they may be more inclined to fly in open spaces or at higher altitudes than *Myotis* species.

4.4.2.2 On-site Surveys (Measurement Endpoint 6b)

Acoustic surveys conducted in fall 2009 and again in spring and summer 2010 documented relatively low activity levels, particularly at detectors mounted near turbine height in met towers. Fall 2009 surveys used 3 detectors, each approximately 15 m above ground. The detectors recorded data for 65 calendar nights (78 detector-nights) and yielded recordings of 191 call sequences (1.1 call sequences per detector-night) (Stantec 2011a). Spring and summer 2010 surveys used 9 detectors: 3 at ground level, 3 in meteorological (met) towers approximately 15 m above ground, and 3 in those same met towers approximately 45 m above ground (near rotor height of proposed turbines). The detectors recorded data for 134 calendar nights (1,097 detector-nights) and yielded recordings of 1,980 call sequences for an overall activity level of 1.8 call sequences per detector-night (Stantec 2011b). Detailed descriptions of the methods and results of these surveys can be found in corresponding survey reports.

Fall 2009 documented the highest call volumes in August and September (49% of total recorded call sequences for both months) which likely coincides with bat migration, then declined during October when all detectors recorded a monthly average of less than 1.0 call/detector night. The most frequently recorded guild during the fall 2009 surveys was the big brown and silver-haired bat guild, representing 46.1 percent of the total recorded call sequences for that survey period (Stantec 2011a). Spring and summer 2010 surveys, which provided a more robust dataset with a total of 9 detectors, documented an increase in bat activity levels between April and June, a peak in activity in July, and a decline from July to August. Though activity levels declined from July to August, activity levels were higher in August than in June. Notably, of the 1,980 call sequences recorded during the 2010 surveys, 85.6 percent were recorded by the ground level detectors. Ground level detectors typically record activity of foraging bats (as many species of bat in the east forage below tree canopy level), and individual foraging bats may make multiple passes by a detector during a night; detectors at greater heights are more likely to record migrant bats typically making a single pass in a night if actively migrating. As for the peak in activity in July, the peak detector night at each of the 3 ground detectors occurred in July and accounted for 457 (23.1%) of total call sequences recorded during the entire survey period. As is often observed in acoustic bat surveys, species composition differed between ground-level detectors and met-tower detectors during the spring 2010 surveys, with *Myotis* species being detected far more frequently near the ground than above the forest canopy. Of the call sequences that were decipherable to guild (56.3% of total recorded call sequences) during the spring 2010 acoustic surveys, the big brown and silver-haired bat guild were detected most frequently (28.3% of total recorded call sequences). Also, of the call sequences that were decipherable to guild, hoary bats and the big brown and silver-haired bat guild made up the majority of calls recorded at the 3 detectors located near rotor zone height of proposed turbines (Stantec 2011b).

In comparison to similar studies conducted at other proposed wind projects in the east, bat activity levels recorded within the Project area were generally low (see Appendix B Table 4 in Stantec 2011a and Appendix B Table 10 in Stantec 2011b), although direct comparison of acoustic activity levels among sites cannot reliably inform the number of bats that will be impacted during operations at a proposed project. Variation in detection rates typical for results of acoustic surveys are due to a variety of factors (Hayes 1997; Hayes 2000). More relevant to this Project are the timing results of bat activity levels and the results of species composition recorded at different heights above ground level. Activity levels were highest in August and September during the fall 2009 survey. During the 2010 survey, activity levels were highest in July, when a peak in activity occurred, and August. Species composition near the rotor zone height of proposed turbines was mostly comprised of long distance migratory species, including silver-haired and hoary bats. Risk of collision mortality at the Project would therefore be expected to be greatest between July and September and greatest for long-distance migratory species.

Mist net surveys were conducted at the request of NHFG, due to the recent decline in bat populations as a result of WNS, and the presence of a bat hibernaculum in the Project vicinity. The hibernaculum was last surveyed in 2007 and at that time contained 3 little brown bats and 57 northern long-eared bats (New Hampshire Natural Heritage Bureau 2010). In New Hampshire, the northern long-eared bat is a state species of special concern and may soon be listed as threatened or endangered due to significant population declines as a result of WNS. Therefore the mist net surveys were conducted with a focus on northern long-eared bats. Mist net sites were placed along the higher elevation ridgelines within the Project area where turbines are being proposed so that individuals captured could be considered to be using the ridges, and therefore at risk of direct impacts from the wind facility. Out of a total of 10 survey nights, only one individual was captured during 50.5 survey hours at five survey sites. The individual was a juvenile female big brown bat, captured at the Braley Mountain mist net survey site (see Figure 3-1) and had no evidence of WNS in the form of membrane depigmentation or scarring. The big brown bat is neither a federally or stated listed species.

Overall, measurement endpoint 6b indicates a moderate potential for collision mortality based on comparison to other sites (Table 4-9). Potential impacts are expected to vary by season, following patterns observed at other operational wind facilities, particularly those in New England with impacts being greatest during the fall migration period. Potential impacts are also expected to vary by species, due to behavioral factors, relative abundance, and documented patterns in collision mortality, as discussed below.

4.4.2.2.1 Long-distance Migratory Bat Species

Hoary, red, and silver-haired bats were all documented during acoustic surveys, indicating the presence of each species within the Project area. Long-distance migrants were recorded more often by detectors near the rotor zone height of proposed turbines than were *Myotis* species, suggesting that long-distance migratory species tend to fly higher than other species and would therefore be at greater risk of collision mortality. The biology of these species (Cryan and Brown 2007, Kunz *et al*. 2007a) and their high rates of mortality during the fall at existing wind facilities suggest that they are more vulnerable to collision mortality at the Project than other bat species.

4.4.2.2.2 Tri-colored bats

Tri-colored bats were documented during acoustic surveys, indicating their presence in the Project area, although their call sequences were identified infrequently. Available post-construction data suggest that this species is among species more vulnerable to collision mortality (Kunz *et al.* 2007a), suggesting potential risk of collision mortality at this Project.

4.4.2.2.3 *Myotis* species

Myotis species were documented at each detector during the fall 2009 acoustic survey and at each of the ground detectors during the 2010 acoustic survey. *Myotis* species tend to be active below the forest canopy (Arnett *et al.* 2006), and therefore are not at as great a risk of collision as those species that are more often active in the rotor-swept zone. Further, WNS has decimated the populations of *Myotis* species, making them rare on the landscape and presumably at a lower risk of collision.

4.4.2.2.4 Big Brown Bats

Big brown bats were documented during acoustic surveys in 2009 and at met tower detectors in 2010. Further, one individual was caught during the mist net survey in 2011. These results indicate their presence in the Project area, and observations at met tower detectors indicate some risk of collision with wind turbines. However, the results of post-construction surveys suggest risk to this species is low despite activity above the forest canopy (Kunz *et al*. 2007a).

4.4.3 Indirect Impacts to Bats (Assessment Endpoint 7)

4.4.3.1 Literature Review (Measurement Endpoint 7a)

In addition to direct collision mortality, the construction of wind energy facilities has the potential to cause indirect impacts such as habitat loss, habitat conversion, and displacement of bats. Although no studies have measured the response of existing bat communities to the creation of a wind facility and its associated infrastructure, several effects could be expected.

If existing forest stands were removed during the creation of access roads and turbines pads, available roosting habitat could be reduced. The magnitude of impact on local bats communities would vary based on the quality and quantity of habitat removed and the availability of alternate habitat of comparable quality and character. For example, removal of large diameter dead and declining trees of many species would constitute removal of high quality roosting habitat. Additionally, if the habitat conversion lowered the overall habitat diversity of an area, it could negatively affect the bat community (Hayes and Loeb 2007). The duration of the impact would vary depending on whether the original habitat was allowed to revert to its pre-construction condition or whether the habitat would be permanently lost. Long-term loss of habitat would be incurred where the forest was cleared for turbine placement, thus preventing recruitment of potential snags for the near future.

In some cases, conversion from forested to non-forest habitat could result in short or long-term benefits to local bat communities, depending upon the configuration of the surrounding forested landscape. For example, forest gaps and clearings create additional foraging opportunities, as documented by higher levels of bat activity in fields, edges, and clearings (Hayes and Loeb 2007). This apparent enhancement of foraging habitat is possibly a function of reduction in clutter rather than enhancement of insect (prey) habitat. Depending on the size, plant species composition and diversity, and surrounding habitats, fields have been shown to produce lower insect diversity and abundances, but may still be close enough to forest habitat to still maintain insect levels suitable for bat foraging (Burford *et al*. 1999, Dodd 2006). Creation of forest gaps and clearing has been recommended as a management technique for some species (Krusic *et al*. 1996), but not all bat species in the eastern U.S. would benefit from such practices (Owen *et al*. 2003). However, foraging habitat is typically present in far greater abundance than roosting habitat, and therefore any potential increase in foraging habitat would not outweigh potential loss of roosting habitat if suitable trees/stands are removed during construction.

Overall, the literature review indicates the potential for indirect impacts to bats, from removal of roost trees (impacts to rock habitat discussed in 4.4.3.2), creation of edge habitat, and construction of wind turbines, which may affect the distribution and movement patterns of bats in an area. Results from other wind projects and general understanding of how bats utilize habitat suggest that the creation of edge habitat and clearing associated with the Project will likely cause a shift in bat activity patterns along the ridgeline, increasing the amount of foraging habitat, possibly creating flight corridors along the ridgeline (similar to the existing roads). While some of these impacts are not necessarily harmful to bats, the Project may influence the distribution and possibly species composition of bats within the Project (Table 4-9).

4.4.3.2 Habitat Characterization (Measurement Endpoint 7b)

Project turbines and infrastructure are located primarily within hardwood and mixed hardwood-softwood forests. The Project area is primarily forested yet includes numerous flight corridors, forest gaps, water-sources, and diverse roosting potential. Flight corridors are typically linear features which offer natural flight paths for navigation and low-clutter foraging habitat (Hayes and Loeb 2007, Lacki *et al*. 2007), and occur as forest roads, timber harvesting clearings, and 'hard' edges within the Project area. Forest gaps are also important, and have been shown to have higher levels of bat activity than surrounding habitat in several studies (Hayes and Loeb 2007, Lacki *et al*. 2007, Menzel *et al*. 2002, Tibbels and Kurta 2003). Forest gaps at the Project occur primarily as clearings for man-made structures (e.g., timber harvest clearings and met towers) and currently as timber harvest clearings.

Creation of cleared areas for turbines and Project infrastructure will result in the development of some additional edge habitat within forested stands and may result in an increase in the amount of available foraging habitat for bats. However, clearing of forest associated with turbines and infrastructure may potentially remove roosting habitat for some species as currently occurs as a result of timber harvests. Because foraging habitat is abundant within the Project area, roosting habitat is a more likely limiting factor for local bat species. Generally speaking, ridgetop habitat contains fewer open water wetlands, shorter tree canopy height, and generally harsher conditions than are present at lower elevations within the Project area making this habitat less suitable for roosting. Because tree clearing associated with the Project will primarily affect ridge-top habitats, and because the amount of tree removal will be minimal in comparison to the amount of available habitat, indirect impacts to bats as a result of habitat removal are expected to be minor. Bats are expected to roost where habitat is suitable and forage along the edges of turbine access roads and clearings, as they currently do along edges of existing timber harvesting roads, skidder trails and cleared areas.

4.4.4 Conclusions

When the four types of measurement endpoints used in this analysis (literature review, on-site surveys, and habitat characterization) are considered together, impacts to bats, particularly long-distance migratory species, will likely occur, particularly during the summer and the early fall migration period, given that the highest rates of acoustic activity were documented at the site during this time period and based on patterns documented during post-construction surveys in the eastern U.S. Results of post-construction surveys provide the most relevant information in predicting patterns in mortality at the Project. Therefore, impacts to bats from the Project are most likely to affect long distance migratory species (e.g., hoary, red, and silver-haired), little brown myotis, tri-colored bats, and big brown bats given that these species have been found to be killed most frequently at currently operating wind farms in New England. Acoustic surveys revealed higher levels of activity for silver-haired and hoary bats, above canopy height, potentially indicating the presence of migratory individuals passing through the Project area. Moreover, most bats expected to collide with turbines are likely to be migrating individuals rather than resident bats. The relatively small number of relevant studies and the variability between results of surveys presently makes it impossible to predict levels of mortality at the Project with certainty. However, it is expected that the Project will have similar levels of mortality to other operational wind projects on forested ridges in New England, including the Lempster, Granite Reliable, and Groton Wind Projects which are similar in elevation and habitat to the Wild Meadows Wind Project and have documented low levels of mortality (Appendix B, Table 16). Indirect impacts to bats are expected to be minor at the Project, given the relatively small amount of anticipated clearing and the already disturbed forest condition within the Project area due to timber harvest practices.

Table 4-14. Concurrence among measurement endpoints for bats at the Wild Meadows Wind Project

Increasing Evidence of Risk ↑	**Evidence of Impact?/ Magnitude?**	**Weighting Factors**				
		Low	**Low/ Medium**	**Medium**	**Medium/ High**	**High**
	Yes / High					
	Yes / Moderate		**6a**			
	Yes / Low		**7a**	**6b, 7b**		
	No					
	Undetermined				**6c**	
	Increasing Confidence or Weight →					

6a	Literature Review (Potential collision morality of bats)
6b	On-site Field Surveys (Potential collision morality of bats)
6c	Weather Analysis (Potential collision morality of bats)
7a	Literature Review (Indirect impacts)
7b	Habitat Characterization (Indirect impacts)

5.0 Summary and Conclusions

This document attempts to make the most appropriate use of a combination of types of data ranging from on-site field surveys to regional databases to assess potential impacts to birds and bats associated with construction of a wind energy facility in Grafton and Merrimack Counties, New Hampshire. The WOE approach provides a means to use all available data to the extent that it can be used to predict risk of direct and indirect impacts to birds and bats.

While the predictions made in this assessment contain uncertainty, additional pre-construction data would not necessarily facilitate more accurate predictions of risk to birds and bats. At present, no pre-construction survey techniques allow for quantitative prediction of risk to bird and bat resources, given the complexity of ecological, climatic, seasonal, and behavioral factors that likely play roles in influencing rates of direct and indirect impacts to bird and bat resources. The primary difficulties encountered in predicting risk of collision mortality and indirect impacts associated with wind facilities include the lack of understanding of factors causing birds and bats to collide with wind turbines, the influence site location may play on collision factors, and the inadequately established relationship between pre-construction and post-construction survey results.

Of the four groups of species considered in this assessment (raptors, nocturnally migrating passerines, breeding birds, and bats), potential impacts to bats are likely to be greatest, as bats tend to reproduce slowly and have longer life spans than birds, and as rates of collision mortality at existing wind farms tend to be higher for bats than for breeding birds, raptors, or nocturnally migrating passerines. Also, less is known about the behaviors and mechanisms of collision for bats than for the other groups. On-site surveys revealed relatively low rates of bat activity, but notably, hoary bats and silver-haired bats (long-distance migratory species) comprised the majority of bat activity recorded near turbine height. However, potential risks posed to bats are not unique to this Project, and bat activity levels are likely similar to those on other forested ridgelines in the region, particularly the Lempster Wind Project.

Potential impacts to other species studied for this Project, specifically raptors, nocturnally migrating passerines and breeding birds will likely occur at a low magnitude, although data from existing facilities suggests that the bird group most susceptible to collision is nocturnally migrating passerines given the timing and species composition of observed mortalities at other operational wind facilities. However, mortality rates for nocturnally migrating passerines at the Lempster, Granite Reliable, and Groton Wind Projects were within the range of results of other mortality monitoring surveys conducted at existing windfarms in the eastern U.S. Since passage rates documented during pre-construction radar surveys at the Lempster Wind Project were on the high end of the range of results recorded for other publicly available studies in the Northeast, collision mortality of nocturnally migrating passerines at the Wild Meadows Wind Project may also be within the range of results of other mortality monitoring surveys conducted at existing windfarms in the eastern U.S. Based on the similarities (i.e., elevation, habitat, and pre-construction survey results) between Lempster, Granite Reliable, Groton, and the Wild Meadows Wind Project, it is expected that collision risk to birds will be low to moderate.

When viewed together, most assessment and measurement endpoint pairs indicate that potential impacts will occur, but that the magnitude of impacts will be low (Table 5-1). One endpoint (literature review) suggested moderate magnitudes of impact to migratory bats. However, the literature review may have been skewed by including post-construction survey results from developed wind projects outside of New England where bat mortality has been significantly higher. As described in the preceding sections, risk of impacts for each group will vary by time of year, conditions, species, season, and presumably by particular aspects of the site. Because it is therefore difficult and perhaps misleading to summarize potential impacts too broadly, the purpose of Table 5-1 is to help understand the process followed within this document and the WOE approach to assessing potential impacts associated with the Project.

Table 5-1. Concurrence among measurement endpoints for raptors, nocturnally migrating passerines, breeding birds, and bats at the Wild Meadows Wind Project

Increasing Evidence of Risk	Evidence of Impact?/ Magnitude?	Weighting Factors				
		Low	**Low/ Medium**	**Medium**	**Medium/ High**	**High**
	Yes / High					
	Yes / Moderate		**6a**			
	Yes / Low		**1a, 2a, 3a, 4a, 5a, 7a**	**2b, 3b, 5b, 6b, 7b**	**1b, 4b**	
	No					
	Undetermined				**6c**	
	Increasing Confidence or Weight					

1a	Literature Review (Potential collision mortality of raptors)
1b	Raptor Migration Surveys (Potential collision mortality of raptors)
2a	Literature Review (Indirect impacts to raptors)
2b	Habitat Characterization (Indirect impacts to raptors)
3a	Literature Review (Potential collision mortality of nocturnally migrating passerines)
3b	Radar Surveys (Potential collision mortality of nocturnally migrating passeries)
4a	Literature Review (Potential collision mortality of breeding birds)
4b	On-site Raptor Surveys (Potential collision morality of breeding birds)
5a	Literature Review (Indirect impacts to breeding birds)
5b	Habitat Characterization (Indirect impacts to breeding birds)
6a	Literature Review (Potential collision morality of bats)
6b	On-site Field Surveys (Potential collision morality of bats)
6c	Weather Analysis (Potential collision morality of bats)
7a	Literature Review (Indirect impacts)
7b	Habitat Characterization (Indirect impacts)

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Appendix A

Agency Correspondence

Memo

To:	Sarah Emery, Atlantic Wind LLC Ed Cherian, Atlantic Wind LLC Kristen Goland, Atlantic Wind LLC	From:	Adam Gravel, Stantec Consulting
File:	Job #195600532	Date:	October 4, 2012

Reference: **September 28, 2012 Agency Meeting to discuss the Avian and Bat Studies Conducted at Atlantic Wind LLC's Wild Meadows Wind Project, in Grafton and Merrimack Counties, NH.**

This memo summarizes the meeting between USFWS, NHFGD, Atlantic Wind LLC, and Stantec Consulting at USFWS's Concord, NH Office on September 28, 2012 from 8:30 to 11:30 AM. The purpose of the meeting was to provide a project update on Atlantic Wind's Wild Meadows Wind Project to agency staff and to summarize and discuss the avian and bat surveys conducted at the project and the draft reports summarizing the results of those studies. The draft reports were provided to USFWS and NHFG by Atlantic Wind on August 30, 2012 with the exception of the Spring and Fall 2010 Raptor Survey Report, which was submitted to the agencies on September 24, 2012. The draft survey reports submitted included:

- Draft Camera Survey Report,
- Draft Mist Net Survey Report,
- Northern Long-Eared Bat Habitat Assessment and Literature Review,
- Draft 2009 Radar and Acoustic Survey Report,
- Draft 2010 Radar, Acoustic, and Breeding Bird Survey Report, and
- Draft Spring and Fall 2010 Raptor Survey Report.

Attendees included:

Maria Tur, New England Field Office, USFWS
Susi von Oettingen, Endangered Species Biologist, USFWS
John Warner, Assistant Supervisor Federal Activities/ Endangered Species, USFWS
John Kanter, Nongame and Endangered Wildlife Coordinator, NHFGD
Carol Henderson, Environmental Review Coordinator, NHFGD
Sarah Emery, Senior Permitting Manager, Atlantic Wind LLC, Iberdrola Renewables
Ed Cherian, Project Developer, Atlantic Wind LLC, Iberdrola Renewables
Kristen Goland, Atlantic Wind LLC (attended by phone)
Adam Gravel, Project Manager, Stantec Consulting

The meeting began with an introduction of the Project by Ed Cherian (using an overview map of project, including survey locations, roads, turbines, and proposed substation location). Ed explained that Atlantic Wind has leased 6,000 acres of private forestry lands for the project in Danbury, Alexandria, and Grafton, NH and has been working on the project for three years now. The project as currently proposed will be up to 80 Megawatt (MW) and include up to 40 Gamesa 2.0 MW turbines, with a mix of 78 meter (m) and 90 m towers for a maximum tip height of 138.5

m or 454 feet. He said that the project is waiting for the results of the system impact study, but that 80 MW was filed with New England ISO. Ed explained that the number of turbines, location, and infrastructure (access roads, transmission, and substation), had not been completely determined at this time, but that it is 30% designed currently. Ed indicated that the environmental studies have been completed (bird, bat, other wildlife, wetland delineations, and vernal pools), however the wetland delineations will need to be fine-tuned once the project layout is finalized so that impact calculations can be made. He also explained that visual, sound, transportation, economic, and historical and cultural studies are underway. Carol asked about whether or not the transmission line would be under ground or above ground and Ed explained that it is still being investigated and that the lines along the ridge would likely be buried while the lines leading from the project to the substation would be above ground on 34.5 kV lines. Ed explained that although buried lines may be more reliable because they cannot be damaged during storms, etc. they are a lot more expensive because you would need three trenches for the circuits. He also pointed out that buried lines would have greater impacts because in order to bury three lines it would be wider than the access roads creating a greater limit of disturbance. Ed also explained that the project is located in three separate towns (Danbury, Alexandria, and Grafton) and that he is still working with the various towns to work on agreements. Ed also explained that the goal is to file a permit application to the NHSEC by the end of 2012.

Following Ed's introduction of the Project, Adam briefly described the agency consultation history of the Wild Meadows Wind Project. He explained that the first meeting with the USFWS and NHFG occurred on April 1, 2010 and at that time the meeting discussed the proposed work plan for the project and included the standard pre-construction surveys conducted at other projects in the state (radar, raptor, acoustic bat, and breeding bird surveys). During the April 1, 2010 meeting NHFGD recommended adding surveys to assess the potential presence or absence of American Marten as well as mist netting surveys to assess the potential presence or absence of endangered bat species. Subsequent to that meeting, Adam explained the work plan was revised to include camera surveys for martens, a northern long-eared bat habitat assessment and literature review, and mist netting surveys for bats, specifically northern long-eared bats. He also explained that an additional meeting with NHFG, Atlantic Wind, and Stantec occurred on March 31, 2011 to discuss the level of effort, protocol, and survey locations for mist netting surveys. The purpose of this overview was to summarize the consultation history with the agencies and to explain how the surveys and level of effort for studies at the Wild Meadows wind project were determined.

Following Adam's consultation overview, Adam began summarizing the various studies conducted at the project including the methods and results of those studies, starting with the fall 2009 Nocturnal Radar Studies.

<u>Fall 2009 and Spring 2010 Nocturnal Radar Studies</u>
Adam pointed out the radar survey location on the site map and described how radar sampling occurs and what is sampled within the radar's range. He described that the radar sampled migration activity from the highest point on the summit of Melvin Mountain and its range covered a far greater area than just above the ridge. He explained that the results of the study are presented as passage rates, flight heights, flight direction, and percent below turbine height of migrants detected within the 2.8 km wide (1.4 km radius) detection range and did not separate out individuals that were only observed along the ridgeline. He also pointed out that because it is sampling from one location the radar does not account for the difference in elevation changes between different parts of the ridge (just the highest point where the radar was located) and also

doesn't account for targets that are flying over the valleys and those that may even be lower than the elevation of the radar, and base of the turbine at that location. Therefore, the metrics calculated for the nocturnal radar surveys include targets flying over the project area, as well as targets outside of the project area and over the valleys. The table below provides a summary of the two seasons of nocturnal radar studies conducted at the site as Adam described during the meeting.

	Fall 2009	Spring 2010
Survey Effort (# nights)	35 Nights	33 Nights
Passage Rate	980 targets/km/hr	467 targets/km/hr
Average Flight Height	338 m	291 m
Percent below 138.5 m	17%	17%
Mean flight direction	SW (225°)	NE (56°)
PR Variation - lowest	384 targets/km/hr	10 targets/km/hr
PR Variation - highest	2442 targets/km/hr	1379 targets/km/hr

Following Adam's summary of the radar results, Maria asked about the nightly variation observed during each season and asked why we see that variation, if it was common, and which season is more variable than the other. Adam explained that the variation between nights is likely due to variations in weather and that typically the lowest passage rates occur on nights with unfavorable weather for migration and that the highest passage rates typically occur on nights with the most favorable weather for migration. He also explained that in general nights with the highest percentage of targets flying at heights below turbine height occur on nights with low passage rates and vice versa. He also explained that typically the most variability occurs during the spring season, but that each season varies by night based on weather conditions. Ed asked if it were possible to determine which species migrate over the site and what species we have most commonly documented during post construction monitoring studies at other projects. Adam explained that the radar could not differentiate between migrating birds and bats because of their flight speeds and flight direction and that the radar could not identify to individual bird or bat species. He also explained that golden crowned kinglets were among the most common fatality found during post construction studies as well as blackpoll warblers in places like Pennsylvania, where most of the post construction studies have occurred in the northeast. At this time folks asked for the report maps and appendix tables to be formatted to 11X17 for easier reading.

<u>Fall 2009 and Spring and Summer 2010 Acoustic Bat Surveys</u>
Adam pointed out the various bat detector locations on the sit map and explained how many detectors were deployed. Adam explained that three detectors were deployed during the fall 2009 and because no met towers were erected at the site at that time, Stantec deployed the three detectors on portable towers at the locations of the planned met towers at heights of approximately 15 meters. He then explained that the onsite met towers were erected at the site in early spring of 2010 and at that time 9 detectors were deployed within the project area; three in each of the three met towers (Melvin, Tinkham, and Braley). He showed the locations of the detectors on the site map and said that within each met tower one detector was deployed at 45 meters, one at tree canopy height (approximately 20 meters), and one at a height below tree canopy (approximately 3 meters). The tables below provides a summary of the three seasons of acoustic bat studies conducted at the site as Adam described during the meeting.

Summary of bat detector field survey effort and results at Wild Meadows, Fall 2009						
Location	**Dates Deployed**	**Calendar Nights**	**Detector-Nights***	**Recorded Sequences**	**Detection Rate ****	**Maximum Sequences recorded *****
Braley Hill	Aug 20 to Oct 22	64	49	55	1.1	15
Melvin Mountain	Aug 19 to Oct 22	65	65	59	0.9	8
Tinkham Mountain	Aug 20 to Oct 22	64	64	77	1.2	11
Overall Results		***193***	***178***	***191***	***1.1***	--
* One detector-night is equal to a one detector successfully operating throughout the night.						
** Number of bat echolocation sequences recorded per detector-night.						
*** Maximum number of bat passes recorded from any single detector for a detector-night.						

Summary of bat detector field survey effort and results at Wild Meadows, Spring and Summer 2010						
Location	**Dates Deployed**	**Calendar Nights**	**Detector-Nights***	**Recorded Sequences**	**Detection Rate ****	**Maximum Sequences recorded *****
Braley Met High	4/8/10 - 8/19/10	134	112	37	0.3	7
Braley Met Low	4/8/10 - 8/19/10	134	134	86	0.6	11
Braley Ground	4/8/10 - 8/19/10	134	134	615	4.6	116
Melvin Met High	5/12/10 - 8/19/10	100	100	43	0.4	4
Melvin Met Low	4/8/10 - 8/19/10	134	134	45	0.3	3
Melvin Ground	4/8/10 - 8/19/10	134	134	693	5.2	66
Tinkham Met High	5/12/10 - 8/19/10	100	81	25	0.3	3
Tinkham Met Low	4/8/10 - 8/19/10*	134	134	50	0.4	5
Tinkham Ground	4/8/10 - 8/19/10	134	134	386	2.9	275
Overall Results		***1138***	***1097***	***1980***	***1.8***	--
Met Tower Detectors		***736***	***695***	***286***	***0.4***	--
Ground Detectors		***402***	***402***	***1694***	***4.2***	--
* One detector-night is equal to a one detector successfully operating throughout the night.						
** Number of bat echolocation sequences recorded per detector-night.						
*** Maximum number of bat passes recorded from any single detector for a detector-night.						

Adam also explained that the most common species documented were from the Big Brown/Silver-haired bat Guild and that Myotis species comprised the lowest number of calls (2.6%).

Following Adam's summary of the acoustic bat survey results, Susi asked about how they compare with the other pre-construction survey results from other projects in NH. Adam explained that the Wild Meadows site had overall low calls compared to some of the other studies conducted in the state with the detection rates at the low to middle of the range of other studies conducted in NH. Susi also noted that the coupling of the pre and post construction information from NH will help better illustrate potential impacts at proposed future wind projects. Susi asked us to compare the data from the available projects in the State as well as the post construction monitoring results for those projects that have conducted studies and are public to see if there are any geographic similarities. Adam mentioned that this information would be included in the Risk Assessment currently being developed for the project. Susi also looked at the wind speed graphs provided in each of the seasonal reports and was interested in the nightly mean wind speed. She pointed out that wind speeds were at or less than 6 m/s on many of the survey nights. Susi asked us to look at the wind speeds and temperatures for different years at Lempster, Groton, and Wild Meadows to see if this trend is consistent among these other sites. Susi also wanted to see the wind speed data presented with temperature on one graph rather than two graphs as currently presented in the draft reports. Since we were already discussing bats, Adam went on to summarize the mist netting surveys.

<u>2011 Mist Netting Surveys</u>
Adam began by discussing the mist netting locations within the project area and explained that a net site was surveyed on each of the project area ridgelines. He also explained that the mist net locations were discussed and chosen with NHFGD at the meeting on March 31, 2011. He also explained that the survey followed protocols as described in the Indiana Bat Recovery Plan. Adam said that only one bat was captured during the study; a big brown bat. Susi mentioned that she understood why the Indiana Bat survey protocol was followed because that's the only protocol available but said that northern long-eared bats utilize much different habitat than the Indiana bat and wondered if we placed nets within suitable northern long-eared bat habitat. Adam explained that the northern long-eared bat habitat assessment was conducted prior to mist netting surveys so that mist net locations could be identified to target areas that have the highest potential for capturing them. Susi also asked if we tried using the new Echo Class software to analyze acoustic bat data to species and if we planned to use it on the data collected at Wild Meadows. Adam said that it was not used for the data collected at this project and that we have been testing it at various locations in Maine. Adam explained that when Stantec compared the results of Echo Class to our current method of visual analysis Echo Class produces far fewer calls in the results than our visual method and has identified Indiana bats in places where they are not known to occur. Adam said that Stantec is uncomfortable with the software at this time, but Stantec is still testing running some tests with it. There are no plans to analyze Wild Meadows data using Echo Class software.

<u>2010 Camera Survey</u>
Adam began by describing the camera survey and the purpose of the survey. He explained that during the April 1, 2010 meeting with the agencies, NHFG asked for an assessment to determine if the state threatened American marten may be present at the Wild Meadows Project because they appear to be expanding their range in the state, although the closest known occurrence at the time was 30 miles north of the project. Adam explained that camera surveys were conducted because they provide a larger sampling window than winter tracking surveys alone and that the cameras were on site during snow conditions as well which allowed for the observation of tracks during camera visits. Stantec did not see any marten tracks. Adam showed the locations of the trail cameras used during the survey on the site map. A total of 6

cameras were used during the survey each baited with scents and sardines, known to be successful at documenting/capturing marten at other studies conducted in NH. John Kanter asked if we felt that we sampled the project area adequately and if the intensity of camera placement was similar to the GRP study. Adam explained that he felt the cameras were positioned to adequately sample the project area and the habitats representative of the project area. He also explained that the cameras were not just placed in conifer stands and that the various habitat types were sampled, and that the use of scents was used with the idea that it would attract marten to the cameras if they were to occur in the project area. Adam went onto discuss the results of the study. He explained that during the study period, August 5, 2010 through January 5, 2011, no marten were documented with the cameras. (Note: During the meeting Adam said 3 months of survey, but he was incorrect, the survey occurred over 5 months). Adam explained that nearly most mammals known to occur in the state were observed and included fisher, coyote, deer, moose, black bear, snowshoe hare, and red squirrel.

Spring and Fall 2010 Raptor Migration Surveys

Following the summary of the camera surveys, Adam began explaining the methods and results of the spring and fall 2010 raptor migration surveys. Adam explained that the surveys were conducted in collaboration with NH Audubon during both the spring and the fall migration period. Stantec had one observer stationed at the summit of Melvin Mountain [Western Observation Site (WOS)] and NH Audubon had one observer at a location near Grants Pond [Eastern Observation Site (EOS)] for a total of 11 days of survey in spring 2010 and 10 days of survey in fall 2010. Each survey day, both sites were surveyed simultaneously from the two locations by two observers. Adam also explained that during the course of a survey, a raptor may be double-counted if observed by both observers. Also, during hawk migration surveys at established Hawk Migration Association of North America (HMANA) sites, surveys are conducted by more than one observer and if a raptor observed appears to be exhibiting behaviors other than migrating it is not counted (i.e., local behavior such as foraging or perching). During pre-construction surveys conducted at Wild Meadows, Stantec and NH Audubon, documented any raptor observed whether it was suspected to be a local bird or migrant. The tables on the next two pages provide a summary of the two seasons of raptor migration studies conducted at the site

Reference: September 28, 2012 Agency Meeting to Discuss the Avian and Bat Surveys and Wildlife Camera Surveys for the Wild Meadows Wind Project in Grafton and Merrimack Counties, New Hampshire.

A summary of the Spring 2010 survey effort and results at the Wild Meadows Wind Project		
Survey Effort	**WOS**	**EOS**
Range of survey dates	**April 15 - May 26**	
No. survey days	**11 simultaneous surveys**	
No. survey hours	**75.75**	**77**
No. raptor species observed	**10**	
Raptor species observed (common name) from both observation locations combined	**Scientific name**	
American kestrel	*Falco sparverius*	
bald eagle	*Haliaeetus leucocephalus*	
broad-winged hawk	*Buteo platypterus*	
Cooper's hawk	*Accipiter cooperii*	
northen goshawk	*Accipiter gentilis*	
osprey	*Pandion haliaetus*	
red-shouldered hawk	*Buteo lineatus*	
red-tailed hawk	*Buteo jamaicensis*	
sharp-shinned hawk	*Accipiter striatus*	
turkey vulture	*Cathartes aura*	
unidentified accipiter	*n/a*	
unidentified buteo	*n/a*	
unidentified raptor	*n/a*	
Results	**WOS**	**EOS**
Total no. observations of raptors	**62**	**204**
Seasonal passage rate (raptor observations/hour)	**0.82**	**2.65**
Total no. observations of raptors within Project area (percent of total observations)	**45 (73%)**	**170 (83%)**
Total no. of observations of raptors seen in the Project area and below max rotor height (percent of total observations within Project area)	**41 (91%)**	**143 (84%)**

Reference: September 28, 2012 Agency Meeting to Discuss the Avian and Bat Surveys and Wildlife Camera Surveys for the Wild Meadows Wind Project in Grafton and Merrimack Counties, New Hampshire.

A summary of the Fall 2010 survey effort and results at the Wild Meadows Wind Project		
Survey Effort	**WOS**	**EOS**
Range of survey dates	**Sept 14 - Oct 13**	
No. survey days	10 simultaneous surveys	
No. survey hours	67.5	70
No. raptor species observed	12	
Raptor species observed (common name)	**Scientific name**	
American kestrel	*Falco sparverius*	
bald eagle	*Haliaeetus leucocephalus*	
broad-winged hawk	*Buteo platypterus*	
Cooper's hawk	*Accipiter cooperii*	
merlin	*Falco columbarius*	
northern goshawk	*Accipiter gentilis*	
northern harrier	*Circus cyaneus*	
osprey	*Pandion haliaetus*	
rough-legged hawk	*Buteo lagopus*	
red-tailed hawk	*Buteo jamaicensis*	
sharp-shinned hawk	*Accipiter striatus*	
turkey vulture	*Cathartes aura*	
unidentified accipiter	*n/a*	
unidentified buteo	*n/a*	
unidentified raptor	*n/a*	
Results	**WOS**	**EOS**
Total no. observations of raptors	51	294
Seasonal passage rate (raptor observations/hour)	0.76	4.2
Total no. observations of raptors within Project area (percent of total observations)	47 (92%)	239 (81%)
Total no. of observations of raptors seen in the Project area and below max rotor height 138.5 m (percent of total observations within Project area)	42 (89%)	158 (66%)

Adam explained that more observations occurred at the WOS than the EOS and was likely due to the difference in views from the two sites and the fact that the EOS was located in a large field that may have been more attractive to raptors for foraging. Maria asked for more details on the osprey and bald eagle observations listed in tables 2-4a, 2-4b, 2-10a and 2-10b of the draft raptor report, when they were listed as not actively migration. She was wondering if they exhibited foraging activity. Adam did not know that answer to her question and said he would look into it and get back to her. Maria also asked if a nest survey was conducted and Adam said no because he was not aware of any eagle nests within proximity of the project, and New Hampshire Natural Heritage Bureau did not identify any in their response to our information request letter. Adam stated that he is trying to get a hold of bald eagle nest locations in the state. John Kanter suggested that Adam get in touch with Mike Marchand to see if he can get the bald eagle nest locations in the state. John Kanter then asked if we had any golden eagle observations and pointed out that the surveys ended in Mid-October before the peak of golden eagle migration. Adam noted that Stantec did not observe any golden eagles during the survey and while he agreed that the peak period was not covered for golden eagles he referenced figures 2-2 and 2-8 in the report and showed that although the peak was not covered, the surveys occurred during some portion of the migration period for all raptor species known to migrate through the state.

At this time, the conversation moved to a discussion of a site visit for the various agencies. Sarah Emery said that there is currently a site visit planned with DES, ACOE, and EPA on October 9 and 10, 2012 and that NHFG and USFWS was welcome to attend. USFWS asked that Atlantic Wind include USFWS with any meetings with ACOE because they will be reviewing that application and providing comments as well. Atlantic Wind agreed to include them when scheduling meetings with ACOE. Atlantic Wind explained that the site is not accessible by vehicle and that hiking would be necessary. Atlantic Wind also mentioned the possibility of a separate site visit with the USFWS and NHFGD if interested since their interests may be different than DES, ACOE, and EPA. Maria then asked if any discussions had taken place with ACOE, EPA, and DES about wetland mitigation. Ed Cherian explained that Mark Kerns raised mitigation as a question at their last meeting and Ed planned on doing something similar to Groton but have not figured out the impacts yet for Wild Meadows so couldn't begin that process at this time. John Kanter and Carol asked to be involved with mitigation discussions when it came to that point. Carol Henderson also asked if we had any more current information to add to tables 2-13 and 2-14 because the most current information was dated 2010. Adam indicated that there would be a few more current information sources to add as soon as they become public and planned on including that information in the Risk Assessment currently being prepared for the project.

Spring 2010 Breeding Bird Surveys

Adam explained the methods and results of the breeding bird surveys and showed the various breeding bird survey points on the site map. A total of 21 points were surveyed within the project area and 6 control points were surveyed on state owned land on the south side of Mt. Cardigan. The most common species observed were those characteristic of the habitats in the region and included dark-eyed junco, ovenbird, and chestnut-sided warbler. Maria mentioned that the USFWS met last week to discuss a list of birds of conservation concern and ranked them in order of highest conservation concern. Maria pointed out that the Canada warbler that was observed during the surveys was on the list. Adam asked if that list was available to include in the Risk Assessment currently being prepared for the project and Maria and John said that they were not sure if it would be public in time because the deadline wasn't until 2015. Adam said that they have used a similar list and ranking system in Risk Assessments before and would include something similar in the Risk Assessment currently being prepared for the project. Adam mentioned that no state or federally listed species were observed during the surveys. Carol asked if any nighthawks were observed, given that there has been a take at the Lempster Project. Adam said that no nighthawks were observed during the BBS surveys or any of the onsite surveys, including during the nocturnal radar surveys when a biologist was on site at dawn and dusk to operate the radar. This period coincides when nighthawks are actively foraging and flying around, which would be the best times to observe them. He also explained that he found the nighthawk nest during the pre-construction BBS surveys at Lempster, and that helped him key in on areas that may be suitable nesting habitat for nighthawks for the surveys at Wild Meadows. Carol asked if there were any gravel pits in the area that could support nesting nighthawks and Adam wasn’t aware of any. John mentioned that habitat could improve for nesting nighthawks once the project was built and suggested addressing that in the Risk Assessment currently being prepared for the project including ways to deter nighthawks from nesting at the project in the future. Carol mentioned that planting grasses or low blueberries might reduce the use of the pad by nighthawks. Maria also asked if there would be an ABPP for the project and Kristen Goland explained the corporate ABPP and that there would be a Project Specific ABPP prepared for this project. Ed and Adam noted that the site has been logged heavily in many areas, creating open areas and exposed ledge and hardscape, but that no nighthawks were observed.

The meeting ended after all aspects studies and results were discussed. Atlantic Wind closed by letting everyone know they would be happy to take them on site if interested and available and would follow up with everyone with an email for availability.

Action Items:

- Stantec to provide report maps and appendix tables in 11x17 so that they can be more legible.
- Stantec to provide a regional comparison of pre and post construction bat data and weather in NH within the Risk Assessment.
- Stantec to provide Maria with more details regarding the flight behaviors listed in tables 2-4a, 2-4 b, 2-10a, and 2-10b for osprey and bald eagles in the Draft 2010 Raptor Survey report, specifically those that were listed as not actively migrating. This information on flight behaviors will also be added to the Draft 2010 Raptor Migration Report.
- Stantec to add most current post construction studies, once available, to the raptor fatality table in the Draft 2010 Raptor Migration Report as well as newer sources for other species groups.
- Stantec to look at the BBS data and the newest ranking system for species of conservation concern and include in the Risk Assessment, if publicly available.
- Atlantic Wind to prepare and provide a project specific ABPP.
- Atlantic Wind to provide an opportunity for a site visit with USFWS and NHFGD.
- Stantec to finalize draft reports based on comments received by the agencies during the September 28, 2012 meeting.

Memo

NH NATURAL HERITAGE BUREAU
NHB DATACHECK RESULTS LETTER

To: Adam Gravel, Stantec Consulting
30 Park Drive
Topsham, ME 04086

From: Melissa Coppola, NH Natural Heritage Bureau
Date: 11/6/2013 (valid for one year from this date)
Re: Review by NH Natural Heritage Bureau
NHB File ID: NHB13-3321 Town: Danbury, Grafton, Alexandria, Orange
Description: proposed wind project
cc: Kim Tuttle

As requested, I have searched our database for records of rare species and exemplary natural communities, with the following results.

Comments: Please note that there are two attached maps, one with plant and wildlife records in close proximity to the project, the other with bird species and sensitive wildlife habitat within 10 miles of the proposed project (does NOT include plants and natural communities and other wildlife species in the 10 mile radius).

Vertebrate species	**State[1]**	**Federal**	**Notes**
Bald Eagle (*Haliaeetus leucocephalus*)	T	--	Contact the NH Fish & Game Dept (see below).
Sensitive Wildlife Habitat	--	--	Contact the NH Fish & Game Dept (see below).
Northern Harrier (*Circus cyaneus*)*	E	--	Contact the NH Fish & Game Dept (see below).
Osprey (*Pandion haliaetus*)	SC	--	Contact the NH Fish & Game Dept (see below).
Peregrine Falcon (*Falco peregrinus anatum*)	T	--	Contact the NH Fish & Game Dept (see below).
Plant Species			
Sensitive Species (not public information)	T		Please contact NHB to request details about this species. NHB recommends surveys where appropriate habitat exists.

[1]Codes: "E" = Endangered, "T" = Threatened, "SC" = Special Concern, "--" = an exemplary natural community, or a rare species tracked by NH Natural Heritage that has not yet been added to the official state list. An asterisk (*) indicates that the most recent report for that occurrence was more than 20 years ago.

Contact for all animal reviews: Kim Tuttle, NH F&G, (603) 271-6544.

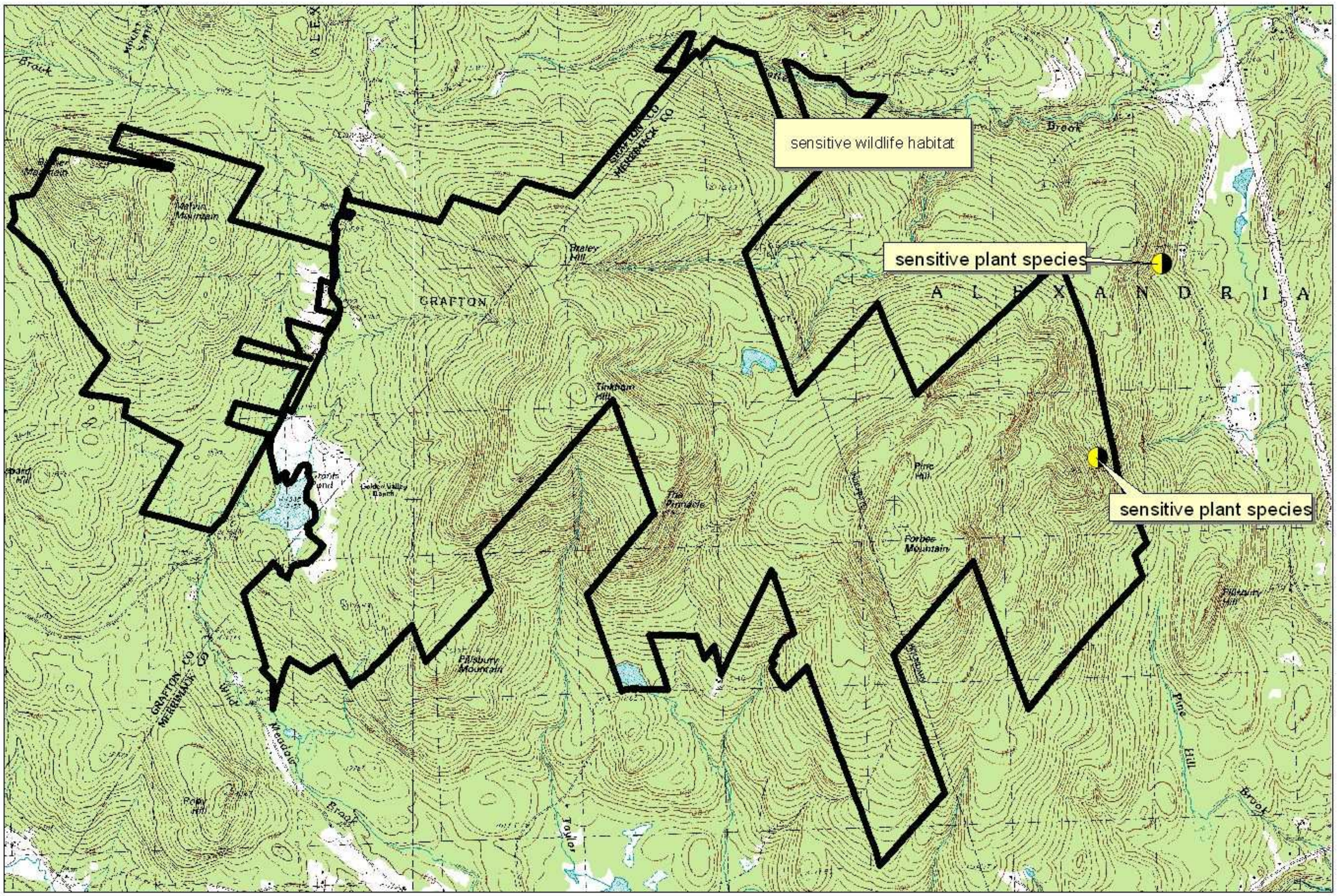
A negative result (no record in our database) does not mean that a sensitive species is not present. Our data can only tell you of known occurrences, based on information gathered by qualified biologists and reported to our office. However, many areas have never been surveyed, or have only been surveyed for certain species. An on-site survey would provide better information on what species and communities are indeed present.

NHB13-3321

NH Natural Heritage Bureau

Known locations of rare species and exemplary natural communities

Note: Mapped locations are not always exact. Occurrences that are not in the vicinity of the project are not shown.



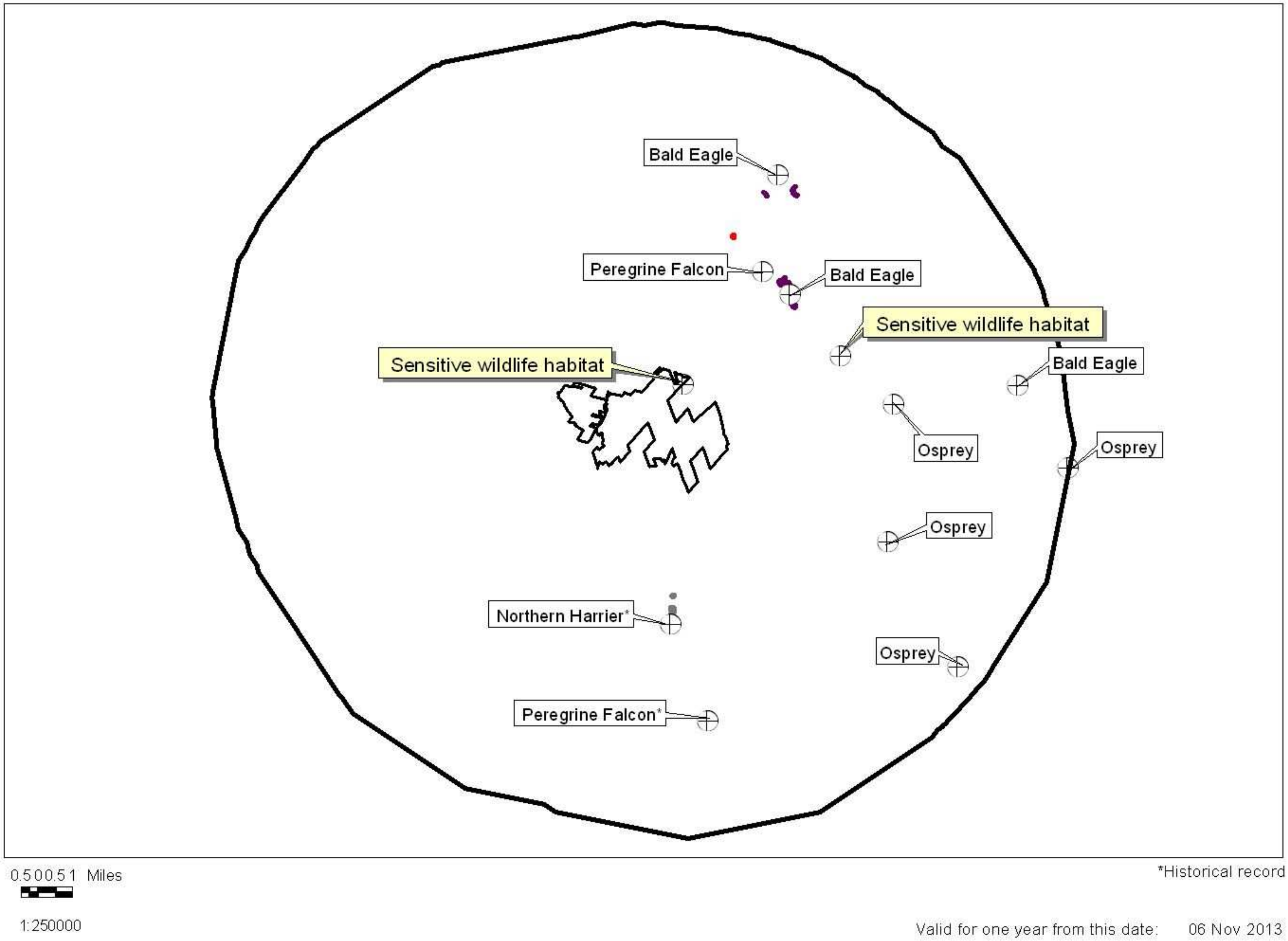
*Historical record

1:39000

Valid for one year from this date: 06 Nov 2013

NH Natural Heritage Bureau

Birds and senstive wildlife habitat within a 10 mile radius of the proposed wind project



*Historical record

Valid for one year from this date: 06 Nov 2013

New Hampshire Natural Heritage Bureau - Animal Record

Bald Eagle (*Haliaeetus leucocephalus*)

Legal Status

Federal: Not listed
State: Listed Threatened

Conservation Status

Global: Demonstrably widespread, abundant, and secure
State: Imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: Wintering eagles regularly observed at this location.2003: Solitary eagles observed at 3 separate locations on 1/10.2002: 1 eagle observed on 1/12. 2 eagles observed at a single location on 12/13. 1 eagle observed on 12/19.
General Area:
General Comments:
Management Comments:

Location

Survey Site Name: Newfound Lake
Managed By: Wellington State Park

County: Grafton
Town(s): Bristol
Size: 56.3 acres

USGS quad(s): Newfound Lake (4307167)
Lat, Long: 433837N, 0714633W
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions:

Dates documented

First reported: 2002-01-12
Last reported: 2003-01-10

New Hampshire Natural Heritage Bureau - Animal Record

Bald Eagle (*Haliaeetus leucocephalus*)

Legal Status

Federal: Not listed
State: Listed Threatened

Conservation Status

Global: Demonstrably widespread, abundant, and secure
State: Imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2013: Nest 1: Nest active, no chicks fledged.2012: Nest 1: 2 chicks fledged.
General Area:
General Comments:
Management Comments:

Location

Survey Site Name: Paradise Point Nature Center
Managed By: Paradise Point Nature Center

County: Grafton
Town(s): Hebron
Size: 1.9 acres

USGS quad(s): Newfound Lake (4307167)
Lat, Long: 434137N, 0714700W
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions:

Dates documented

First reported: 2012
Last reported: 2013

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Bald Eagle (*Haliaeetus leucocephalus*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	Listed Threatened	State:	Imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2011: 1 eagle observed on 2/24.2010: 1 eagle observed on 1/7. 2 eagles observed on 2/28.2009: 1 eagle observed on 2/26.

General Area:
General Comments:
Management Comments:

Location

Survey Site Name: New Hampton Fish Hatchery
Managed By: New Hampton Fish Hatchery

County:	Belknap	USGS quad(s):	Bristol (4307156)
Town(s):	New Hampton	Lat, Long:	433619N, 0713839W
Size:	7.8 acres	Elevation:	

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions:

Dates documented

First reported: 2009-02-26 Last reported: 2011-02-24

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Northern Harrier (*Circus cyaneus*)

Legal Status

Federal: Not listed
State: Listed Endangered

Conservation Status

Global: Demonstrably widespread, abundant, and secure
State: Not ranked (need more information)

Description at this Location

Conservation Rank: Historical records only - current condition unknown.
Comments on Rank:

Detailed Description: 2001: adult female.1992: breeding evidence.1991: young.1986: no young.1988: adult female.1987: pair, 2 young.1985: 1 young.
General Area:
General Comments:
Management Comments:

Location

Survey Site Name: Danbury Bog
Managed By:

County: Merrimack
Town(s): Danbury
Size: 49.1 acres

USGS quad(s): Danbury (4307157)
Lat, Long: 433018N, 0715040W
Elevation: 815 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions:

Dates documented

First reported: 1985
Last reported: 1992

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Osprey (*Pandion haliaetus*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	SC	State:	Not ranked (need more information)

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2007: Nest 3: 2 fledged.2005-2006: Nest 2: 2 fledged.2002-2004: Nest 2: 3 fledged.2001: Nest 2: 2 fledged.2000: Nest 2: 3 fledged.1999: Nest 2: 2 fledged.1997-1998: Nest 2: 3 fledged.1996: Nest 1: adults present.
General Area: Nest 2: nest 8.2m up dead *Pinus strobus* (white pine), dbh 51.1cm. Nest 1: nest 6.7m up dead *Pinus strobus* (white pine), dbh 33cm.
General Comments: 1998: Nest 1, Nest 2: predator guards installed.
Management Comments:

Location

Survey Site Name: Foster Swamp
Managed By: William H Thomas State Forest

County:	Merrimack	USGS quad(s):	Bristol (4307156)
Town(s):	Hill	Lat, Long:	433224N, 0714310W
Size:	1.4 acres	Elevation:	

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: [From Hill, take Rte. 3A north ca. 2 miles to a stream crossing. The site is ca. 0.5 miles from Rte. 3A]

Dates documented

First reported: 1996 Last reported: 2007

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Osprey (*Pandion haliaetus*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	SC	State:	Not ranked (need more information)

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2010: Nest 5: Nest active, no chicks fledged.2008: Nest 4: 3 fledged.2007: Nest 4: 2 fledged.2006: Nest 1: nest not active.2005-2006: Nest 3: nest active, unsuccessful.2004: Nest 2: 1 fledged.2003: Nest 1, Nest 2: adults present.2002: Nset 2: nest active, unsuccessful
General Area: Nest 2: nest 11.9m up dead *Pinus strobus*, dbh 23.6. Nest 1: nest in dead *Pinus strobus*.
General Comments: 2003: Nest 2: predator guard installed.
Management Comments:

Location

Survey Site Name: Franklin Powerline
Managed By:

County:	Merrimack	USGS quad(s):	Franklin (4307146)
Town(s):	Franklin	Lat, Long:	432915N, 0714044W
Size:	2.2 acres	Elevation:	

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: North of Webster Lake. From the intersection of Pemigewasset Rd. and Lake Shore Dr. take Lake Shore Drive ca. 0.3 miles until intersection with a powerline ROW. Nests are 0.5 miles N along powerline ROW.

Dates documented

First reported: 2002 Last reported: 2010

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Osprey (*Pandion haliaetus*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	SC	State:	Not ranked (need more information)

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2004: Area 8281: nest active, unsuccessful.
General Area:
General Comments:
Management Comments:

Location

Survey Site Name: Hermit Lake North
Managed By:

County:	Belknap	USGS quad(s):	Winnisquam Lake (4307155)
Town(s):	Sanbornton	Lat, Long:	433416N, 0713655W
Size:	.4 acres	Elevation:	

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions:

Dates documented

First reported: 2004 Last reported: 2004

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Osprey (*Pandion haliaetus*)

Legal Status
Federal: Not listed
State: SC

Conservation Status
Global: Demonstrably widespread, abundant, and secure
State: Not ranked (need more information)

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2010: Nest 1: 1 fledged.2008: Nest 1: 2 fledged.2007: Nest 1: 3 fledged.
General Area:
General Comments:
Management Comments:

Location

Survey Site Name: Ayers Island Platform
Managed By:

County: Belknap
Town(s): New Hampton
Size: .4 acres

USGS quad(s): Bristol (4307156)
Lat, Long: 433551N, 0714259W
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions:

Dates documented

First reported: 2007
Last reported: 2010

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Peregrine Falcon (*Falco peregrinus anatum*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Threatened	State:	Imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Good quality, condition and landscape context ('B' on a scale of A-D).
Comments on Rank: 2007: Site not active since 1927.

Detailed Description: 2013: Bear Mountain: Nest failed, no chicks fledged.2012: Bear Mountain: 3 chicks fledged.2011: Bear Mountain: 2 chicks fledged.2010: Bear Mountain: 2 chicks fledged. 2009: Bear Mountain: 4 chicks fledged. 2008: Bear Mountain: 2 chicks fledged, not banded. 1927: Breeds. 1898: Pair and young seen N. Dearborn.
General Area:
General Comments: Near the northern end of Newfound Lake is a potential cliff that faces east.
Management Comments:

Location

Survey Site Name: The Ledges
Managed By:

County:	Grafton	USGS quad(s):	Newfound Lake (4307167)
Town(s):	Alexandria	Lat, Long:	433911N, 0714730W
Size:	9.7 acres	Elevation:	900 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: Near Alexandria, western edge of Newfound Lake. "The Ledges" on Sugarloaf Mountain.

Dates documented

First reported: 1898 Last reported: 2013

New Hampshire Natural Heritage Bureau - Animal Record

Peregrine Falcon (*Falco peregrinus anatum*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Threatened	State:	Imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Historical records only - current condition unknown.
Comments on Rank: 2007: Site not active since 1939.

Detailed Description: 2008: Obs 2008: Single individual, no evidence of nesting.1939: Roland W. Burbank (Proctor Academy, Andover) informed C. A. Proctor that a pair used this cliff.
General Area:
General Comments:
Management Comments:

Location

Survey Site Name: Ragged Mountain
Managed By:

County:	Merrimack	USGS quad(s):	Andover (4307147)
Town(s):	Andover	Lat, Long:	432753N, 0714922W
Size:	7.7 acres	Elevation:	1900 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: Ragged Mountain.

Dates documented

First reported: 1939 Last reported: 1939

Appendix B

Bird and Bat Data Tables

Appendix B Table 1: Number of individuals observed by species during fall HMANA surveys conducted at Little Round Top Migration Observatory, Bristol, New Hampshire, 2005 to 2009*.

Species	Scientific Name	NH Status	2005	2006	2007	2008	2009	Avg.
American Kestrel	*Falco sparverius*	SC	16	27	31	14	34	24.4
Bald Eagle	*Haliaeetus leucocephalus*	T	24	25	39	34	56	35.6
Black Vulture	*Coragyps atratus*		0	0	0	0	0	0
Broad-winged Hawk	*Buteo platypterus*		389	1928	743	3125	2376	1712.2
Cooper's Hawk	*Accipiter cooperii*		13	22	41	15	55	29.2
Golden Eagle	*Aquila chrysaetos*	E	2	2	0	1	0	1
Merlin	*Falco columbarius*		3	2	4	1	2	2.4
Northern Goshawk	*Accipiter gentilis*		2	1	1	0	2	1.2
Northern Harrier	*Circus cyaneus*	E	6	2	4	4	8	4.8
Osprey	*Pandion haliaetus*	SC	38	39	46	53	75	50.2
Peregrine Falcon	*Falco peregrinus*	T	4	5	3	0	0	2.4
Red-shouldered Hawk	*Buteo lineatus*		0	0	0	0	0	0
Red-tailed Hawk	*Buteo jamaicensis*		36	20	19	15	25	23
Rough-legged Hawk	*Buteo lagopus*		0	0	0	0	0	0
Sharp-shinned Hawk	*Accipiter striatus*		62	123	118	43	114	92
Turkey Vulture	*Cathartes aura*		33	9	21	25	23	22.2
unidentified accipiter			5	12	14	4	8	8.6
unidentified buteo			18	4	6	3	8	7.8
unidentified eagle			0	0	1	0	1	0.4
unidentified falcon			1	1	1	2	0	1
unidentified raptor			23	28	49	42	78	44
Total			**675**	**2250**	**1141**	**3381**	**2865**	
Average # Observers (range)			**4 (2-9)**	**4 (1-7)**	**4 (2-7)**	**3 (1-6)**	**3 (2-6)**	
# Observation hours			**79**	**100**	**124**	**106**	**151**	
Birds/Hour			**8.54**	**22.50**	**10.76**	**31.90**	**18.97**	

* HMANA surveys were not conducted in 2010 at the Little Round Top Migration Observatory.

Appendix B Table 2: Number of individuals observed by species during fall surveys at HMANA site and proposed wind projects (years specified) in New Hampshire.

Species	Scientific Name	NH Status	Little Round Top, 2009	Lempster Wind Farm, 2005	Granite Reliable, 2009	Groton Wind Farm, 2009	Wild Meadows Wind Project, 2010
American Kestrel	*Falco sparverius*	SC	34	3	1	28	7
Bald Eagle	*Haliaeetus leucocephalus*	T	56	2	10	5	7
Broad-winged Hawk	*Buteo platypterus*		2376	170	104	330	62
Cooper's Hawk	*Accipiter cooperii*		55	4	11	21	7
Golden Eagle	*Aquila chrysaetos*	E	0	0	0	2	0
Merlin	*Falco columbarius*		2	4	2	5	2
Northern Goshawk	*Accipiter gentilis*		2	0	2	1	3
Northern Harrier	*Circus cyaneus*	E	8	4	4	4	2
Osprey	*Pandion haliaetus*	SC	75	12	13	21	12
Peregrine Falcon	*Falco peregrinus*	T	0	2	0	2	0
Red-shouldered Hawk	*Buteo lineatus*		0	0	0	2	0
Red-tailed Hawk	*Buteo jamaicensis*		25	4	54	100	124
Rough-legged Hawk	*Buteo lagopus*		0	0	0	0	1
Sharp-shinned Hawk	*Accipiter striatus*		114	49	25	66	50
Turkey Vulture	*Cathartes aura*		23	9	9	68	59
unidentified accipiter			8	0	1	8	3
unidentified buteo			8	1	1	2	3
unidentified eagle			1	0	1	0	0
unidentified falcon			0	0	0	0	0
unidentified raptor			78	0	4	31	4
Total			**2865**	**264**	**242**	**696**	**346**
Avg. # Observers (range)			**3 (2-6)**	**1**	**2**	**2**	**2**
# Observation Hours			**151**	**80**	**268**	**157**	**138**

Appendix B Table 3: New Hampshire Breeding Bird Atlas Results for Block 8444 (Danbury, NH) and Block 8424 (Grafton, NH). Breeding status: CO (Confirmed Breeding), PR (Probably Breeding), PO (Possible Breeding).

Species	Scientific Name	NH Status	Danbury	Grafton
Alder Flycatcher	*Empidonax alnorum*		PR	PO
American Bittern	*Botaurus lentiginosus*			PO
American Black Duck	*Anas rubripes*		CO	CO
American Crow	*Corvus brachyrhynchos*		PO	CO
American Goldfinch	*Spinus tristis*		PO	PR
American Kestrel	*Falco sparverius*	SC	CO	CO
American Redstart	*Setophaga ruticilla*		PR	CO
American Robin	*Turdus migratorius*		CO	CO
Baltimore Oriole	*Icterus galbula*		PO	CO
Bank Swallow	*Riparia riparia*	SC	CO	
Barn Swallow	*Hirundo rustica*		CO	CO
Belted Kingfisher	*Megaceryle alcyon*		CO	CO
Black-and-white Warbler	*Mniotilta varia*		PO	PR
Black-billed Cuckoo	*Coccyzus erythropthalmus*			PO
Blackburnian Warbler	*Setophaga fusca*		PO	CO
Black-capped Chickadee	*Poecile atricapillus*		CO	CO
Black-throated Blue Warbler	*Setophaga caerulescens*		PR	CO
Black-throated Green Warbler	*Setophaga virens*			PO
Blue Jay	*Cyanocitta cristata*		CO	CO
Blue-gray Gnatcatcher	*Polioptila caerulea*		PO	
Blue-headed Vireo	*Vireo solitarius*		PO	PR
Bobolink	*Dolichonyx oryzivorus*		CO	PR
Broad-winged Hawk	*Buteo platypterus*			PR
Brown Creeper	*Certhia americana*		PO	
Brown Thrasher	*Toxostoma rufum*		PO	PO
Brown-headed Cowbird	*Molothrus ater*		PR	PR
Canada Warbler	*Cardellina canadensis*		PR	PO
Cedar Waxwing	*Bombycilla cedrorum*		PR	CO
Chestnut-sided Warbler	*Setophaga pensylvanica*		PO	CO
Chimney Swift	*Chaetura pelagica*		CO	PR
Chipping Sparrow	*Spizella passerina*		CO	CO
Cliff Swallow	*Petrochelidon pyrrhonota*	SC	CO	
Common Grackle	*Quiscalus quiscula*		CO	CO
Common Raven	*Corvus corax*			PO
Common Snipe	*Gallinago gallinago*		PR	
Common Yellowthroat	*Geothlypis trichas*		CO	CO
Dark-eyed Junco	*Junco hyemalis*			CO
Downy Woodpecker	*Picoides pubescens*		CO	CO
Eastern Bluebird	*Sialia sialis*		CO	
Eastern Kingbird	*Tyrannus tyrannus*		CO	CO
Eastern Meadowlark	*Sturnella magna*	SC	CO	PO
Eastern Phoebe	*Sayornis phoebe*		CO	CO
Eastern Towhee	*Pipilo erythrophthalmus*		PO	PO
Eastern Wood-Pewee	*Contopus virens*		PR	PO
European Starling	*Sturnus vulgaris*		CO	CO
Field Sparrow	*Spizella pusilla*		PO	PO
Golden-crowned Kinglet	*Regulus satrapa*			PO
Gray Catbird	*Dumetella carolinensis*		CO	CO
Great Blue Heron	*Ardea herodias*		PR	PO
Great Crested Flycatcher	*Myiarchus crinitus*		PO	PR
Hairy Woodpecker	*Picoides villosus*		CO	CO
Hermit Thrush	*Catharus guttatus*		PR	PR
Hooded Merganser	*Lophodytes cucullatus*			PR
House Finch	*Carpodacus mexicanus*		PR	PR
House Sparrow	*Passer domesticus*		CO	
House Wren	*Troglodytes aedon*		CO	PO
Indigo Bunting	*Passerina cyanea*		PO	PO
Killdeer	*Charadrius vociferus*		CO	
Least Flycatcher	*Empidonax minimus*		PO	PO
Louisiana Waterthrush	*Parkesia motacilla*		PO	
Magnolia Warbler	*Setophaga magnolia*		PO	PO
Mallard	*Anas platyrhynchos*			CO
Mourning Dove	*Zenaida macroura*		CO	PR

Species	Scientific Name	NH Status	Danbury	Grafton
Nashville Warbler	*Oreothlypis ruficapilla*		CO	PR
Northern Flicker	*Colaptes auratus*		PO	CO
Northern Parula	*Setophaga americana*			PO
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*		CO	
Northern Saw-whet Owl	*Aegolius acadicus*		PR	
Northern Waterthrush	*Parkesia noveboracensis*		PR	PO
Olive-sided Flycatcher	*Contopus cooperi*	SC	PO	PO
Ovenbird	*Seiurus aurocapilla*		PR	PR
Pied-billed Grebe	*Podilymbus podiceps*	T		PO
Pileated Woodpecker	*Dryocopus pileatus*			PO
Pine Siskin	*Spinus pinus*			PO
Prairie Warbler	*Setophaga discolor*		PO	
Purple Finch	*Carpodacus purpureus*		PO	PR
Red-breasted Nuthatch	*Sitta canadensis*		PO	PO
Red-eyed Vireo	*Vireo olivaceus*		CO	CO
Red-shouldered Hawk	*Buteo lineatus*		PO	PO
Red-tailed Hawk	*Buteo jamaicensis*			PO
Red-winged Blackbird	*Agelaius phoeniceus*		CO	CO
Rose-breasted Grosbeak	*Pheucticus ludovicianus*		PR	PR
Ruby-throated Hummingbird	*Archilochus colubris*		PO	PR
Ruffed Grouse	*Bonasa umbellus*		CO	PR
Savannah Sparrow	*Passerculus sandwichensis*		CO	
Scarlet Tanager	*Piranga olivacea*		CO	PR
Sharp-shinned Hawk	*Accipiter striatus*			PO
Song Sparrow	*Melospiza melodia*		CO	CO
Swamp Sparrow	*Melospiza georgiana*		CO	CO
Tree Swallow	*Tachycineta bicolor*		CO	CO
Turkey Vulture	*Cathartes aura*			PO
Veery	*Catharus fuscescens*		PR	PR
Warbling Vireo	*Vireo gilvus*		PO	
White-breasted Nuthatch	*Sitta carolinensis*		PR	CO
White-throated Sparrow	*Zonotrichia albicollis*		CO	CO
Willow Flycatcher	*Empidonax traillii*			PO
Winter Wren	*Troglodytes hiemalis*		PO	
Wood Duck	*Aix sponsa*			PO
Wood Thrush	*Hylocichla mustelina*		PO	CO
Yellow Warbler	*Setophaga petechia*		CO	PO
Yellow-bellied Sapsucker	*Sphyrapicus varius*		PR	PO
Yellow-rumped Warbler	*Setophaga coronata*		PO	PR
Yellow-throated Vireo	*Vireo flavifrons*		PO	

Appendix B Table 4: New Hampshire Breeding Birds Atlas Results for Mount Cardigan, Orange, NH.

Species	Scientific Name	NH Status	Breeding
Barred Owl	*Strix varia*		Possible
Bicknell's Thrush	*Catharus bicknelli*	SC	Possible
Blackburnian Warbler	*Setophaga fusca*		Possible
Blackpole Warbler	*Setophaga striata*		Possible
Black-throated blue Warbler	*Setophaga caerulescens*		Possible
Black-Throated green Warbler	*Setophaga virens*		Possible
Blue-headed Vireo	*Vireo solitarius*		Possible
Common Raven	*Corvus corax*		Possible
Dark-eyed Junco	*Junco hyemalis*		Possible
Eastern Towhee	*Pipilo erythrophthalmus*		Possible
Hermit Thrush	*Catharus guttatus*		Possible
Magnolia Warbler	*Setophaga magnolia*		Possible
Nashville Warbler	*Oreothlypis ruficapilla*		Possible
Pileated Woodpecker	*Dryocopus pileatus*		Possible
Pine Siskin	*Spinus pinus*		Possible
Purple Finch	*Carpodacus purpureus*		Possible
Red-breasted Nuthatch	*Sitta canadensis*		Possible
Ruffed Grouse	*Bonasa umbellus*		Possible
Swainson's Thrush	*Catharus ustulatus*		Possible
White-throated Sparrow	*Zonotrichia albicollis*		Possible
Yellow-bellied Flycatcher	*Empidonax flaviventris*		Possible
Yellow-bellied Sapsucker	*Sphyrapicus varius*		Possible
Yellow-rumped Warbler	*Setophaga coronata*		Possible

Appendix B Table 5: Summary of Breeding Bird Survey Route 58011, Wilmot, NH.

Species Name	Scientific Name	NH Status	Birds/Route
Alder Flycatcher	*Empidonax alnorum*		1.95
American Bittern	*Botaurus lentiginosus*		0.27
American Black Duck	*Anas rubripes*		0.16
American Crow	*Corvus brachyrhynchos*		11.41
American Goldfinch	*Spinus tristis*		7.14
American Kestrel	*Falco sparverius*	SC	0.07
American Redstart	*Setophaga ruticilla*		8.27
American Robin	*Turdus migratorius*		23.43
American Woodcock	*Scolopax minor*		0.02
Baltimore Oriole	*Icterus galbula*		2.05
Bank Swallow	*Riparia riparia*	SC	3.16
Barn Swallow	*Hirundo rustica*		7.11
Barred Owl	*Strix varia*		0.16
Belted Kingfisher	*Megaceryle alcyon*		0.34
Black-and-white Warbler	*Mniotilta varia*		5.36
Black-billed Cuckoo	*Coccyzus erythropthalmus*		0.11
Blackburnian Warbler	*Setophaga fusca*		2.16
Black-capped Chickadee	*Poecile atricapillus*		15.89
Black-throated Blue Warbler	*Setophaga caerulescens*		6.55
Black-throated Green Warbler	*Setophaga virens*		4.95
Blue Jay	*Cyanocitta cristata*		12.27
Blue-headed Vireo	*Vireo solitarius*		3.64
Bobolink	*Dolichonyx oryzivorus*		3.32
Broad-winged Hawk	*Buteo platypterus*		0.5
Brown Creeper	*Certhia americana*		0.57
Brown Thrasher	*Toxostoma rufum*		0.93
Brown-headed Cowbird	*Molothrus ater*		5
Canada Goose	*Branta canadensis*		0.16
Canada Warbler	*Cardellina canadensis*		1.66
Cedar Waxwing	*Bombycilla cedrorum*		11.82
Chestnut-sided Warbler	*Setophaga pensylvanica*		13.95
Chimney Swift	*Chaetura pelagica*		3.09
Chipping Sparrow	*Spizella passerina*		9.43
Cliff Swallow	*Petrochelidon pyrrhonota*	SC	0.25
Common Grackle	*Quiscalus quiscula*		6.48
Common Nighthawk	*Chordeiles minor*	E	0.05
Common Raven	*Corvus corax*		2.18
Common Snipe	*Gallinago gallinago*		0.14
Common Yellowthroat	*Geothlypis trichas*		14.16
Dark-eyed Junco	*Junco hyemalis*		2.23
Downy Woodpecker	*Picoides pubescens*		1.27
Eastern Bluebird	*Sialia sialis*		0.8
Eastern Kingbird	*Tyrannus tyrannus*		3.09
Eastern Meadowlark	*Sturnella magna*	SC	0.2
Eastern Phoebe	*Sayornis phoebe*		7.77
Eastern Towhee	*Pipilo erythrophthalmus*		3.66
Eastern Whip-poor-will	*Caprimulgus vociferus*	SC	0.39
Eastern Wood-Pewee	*Contopus virens*		3.25
European Starling	*Sturnus vulgaris*		12.25
Evening Grosbeak	*Coccothraustes vespertinus*		0.55
Field Sparrow	*Spizella pusilla*		0.91
Golden-crowned Kinglet	*Regulus satrapa*		0.14
Gray Catbird	*Dumetella carolinensis*		5.59
Great Blue Heron	*Ardea herodias*		0.23
Great Crested Flycatcher	*Myiarchus crinitus*		1.59
Green Heron	*Butorides virescens*		0.02
Hairy Woodpecker	*Picoides villosus*		1.36
Hermit Thrush	*Catharus guttatus*		5.39
Hooded Merganser	*Lophodytes cucullatus*		0.2
House Finch	*Carpodacus mexicanus*		0.39
House Sparrow	*Passer domesticus*		0.52
House Wren	*Troglodytes aedon*		1.3
Indigo Bunting	*Passerina cyanea*		1.66

Species Name	Scientific Name	NH Status	Birds/Route
Killdeer	*Charadrius vociferus*		0.41
Least Flycatcher	*Empidonax minimus*		5.43
Louisiana Waterthrush	*Parkesia motacilla*		0.05
Magnolia Warbler	*Setophaga magnolia*		1.75
Mallard	*Anas platyrhynchos*		0.14
Marsh Wren	*Cistothorus palustris*		0.05
Mourning Dove	*Zenaida macroura*		6.8
Mourning Warbler	*Geothlypis philadelphia*		0.02
Nashville Warbler	Oreothlypis ruficapilla		1.05
Northern Cardinal	Cardinalis cardinalis		0.11
Northern Flicker	*Colaptes auratus*		1.75
Northern Harrier	*Circus cyaneus*	E	0.02
Northern Mockingbird	*Mimus polyglottos*		0.02
Northern Parula	*Setophaga americana*		0.16
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*		0.05
Northern Waterthrush	*Parkesia noveboracensis*		0.98
Olive-sided Flycatcher	*Contopus cooperi*	SC	0.16
Ovenbird	*Seiurus aurocapilla*		30.45
Philadelphia Vireo	*Vireo philadelphicus*		0.02
Pied-billed Grebe	*Podilymbus podiceps*	T	0.05
Pileated Woodpecker	*Dryocopus pileatus*		1.8
Pine Warbler	*Setophaga pinus*		1.09
Prairie Warbler	*Setophaga discolor*		0.23
Purple Finch	*Carpodacus purpureus*		2.64
Red Crossbill	*Loxia curvirostra*		0.14
Red-breasted Nuthatch	*Sitta canadensis*		1.7
Red-eyed Vireo	*Vireo olivaceus*		43.48
Red-shouldered Hawk	*Buteo lineatus*		0.09
Red-tailed Hawk	*Buteo jamaicensis*		0.02
Red-winged Blackbird	*Agelaius phoeniceus*		16.32
Rock Dove	*Columba livia*		0.36
Rose-breasted Grosbeak	*Pheucticus ludovicianus*		4.57
Ruby-crowned Kinglet	*Regulus calendula*		0.02
Ruby-throated Hummingbird	*Archilochus colubris*		0.98
Ruffed Grouse	*Bonasa umbellus*		0.09
Rusty Blackbird	*Euphagus carolinus*	SC	0.02
Sapsucker (3 species)	*Sphyrapicus spp.*		4.8
Savannah Sparrow	*Passerculus sandwichensis*		0.14
Scarlet Tanager	*Piranga olivacea*		5.98
Sharp-shinned Hawk	*Accipiter striatus*		0.02
Song Sparrow	*Melospiza melodia*		10.25
Spotted Sandpiper	*Actitis macularius*		0.02
Swainson's Thrush	*Catharus ustulatus*		0.16
Swamp Sparrow	*Melospiza georgiana*		5.07
Tree Swallow	*Tachycineta bicolor*		12.16
Tufted Titmouse	*Baeolophus bicolor*		0.93
Turkey Vulture	*Cathartes aura*		0.02
Veery	*Catharus fuscescens*		17.86
Vesper Sparrow	*Pooecetes gramineus*	SC	0.07
Warbling Vireo	*Vireo gilvus*		1.07
White-breasted Nuthatch	*Sitta carolinensis*		1.77
White-throated Sparrow	*Zonotrichia albicollis*		10.2
Wild Turkey	*Meleagris gallopavo*		0.18
Willow Flycatcher	*Empidonax traillii*		0.11
Willow/Alder Flycatcher	*Empidonax spp.*		2.07
Winter Wren	*Troglodytes hiemalis*		3.95
Wood Duck	*Aix sponsa*		0.25
Wood Thrush	*Hylocichla mustelina*		17.59
Yellow Warbler	*Setophaga petechia*		3.55
Yellow-bellied Flycatcher	*Empidonax flaviventris*		0.07
Yellow-bellied Sapsucker	*Sphyrapicus varius*		4.8
Yellow-billed Cuckoo	*Coccyzus americanus*		0.05
Yellow-rumped Warbler	*Setophaga coronata*		3.64
Yellow-throated Vireo	*Vireo flavifrons*		0.11

Appendix B Table 6: Summary of Christmas Bird Count results for the Grafton-Bristol Count Circle (NHGB), NH.

Species	Scientific Name	NH Status	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009
American Black Duck	*Anas rubripes*		8	10	25		12
American Crow	*Corvus brachyrhynchos*		23	83	114	31	95
American Goldfinch	*Spinus tristis*		124	34	169	20	276
American Robin	*Turdus migratorius*		1	2	24	5	182
American Tree Sparrow	*Spizella arborea*		12	14	27	24	30
Bald Eagle	*Haliaeetus leucocephalus*	T	1			1	1
Barred Owl	*Strix varia*			1	1	3	
Belted Kingfisher	*Megaceryle alcyon*		1	1		1	
Black-capped Chickadee	*Poecile atricapillus*		682	742	803	1008	894
Blue Jay	*Cyanocitta cristata*		50	553	148	147	407
Bohemian Waxwing	*Bombycilla garrulus*			353		42	4
Brown Creeper	*Certhia americana*		9	14	9	4	10
Canada Goose	*Branta canadensis*				28		
Carolina Wren	*Thryothorus ludovicianus*						1
Cedar Waxwing	*Bombycilla cedrorum*		16	32	9	4	86
Common Goldeneye	*Bucephala clangula*		10	4	22	5	12
Common Loon	*Gavia immer*	T	2			7	
Common Merganser	*Mergus merganser*		14		6	6	
Common Raven	*Corvus corax*		2	19	26	19	74
Common Redpoll	*Acanthis flammea*			90		141	
Cooper's Hawk	*Accipiter cooperii*		2	2		1	
Dark-eyed Junco	*Junco hyemalis*		82	24	176	5	64
Downy Woodpecker	*Picoides pubescens*		28	35	42	31	39
European Starling	*Sturnus vulgaris*		48	92	338	255	348
Evening Grosbeak	*Coccothraustes vespertinus*			13		10	
Golden-crowned Kinglet	*Regulus satrapa*		6	7	35		1
Hairy Woodpecker	*Picoides villosus*		12	32	25	23	25
Herring Gull	*Larus argentatus*					1	1
Hooded Merganser	*Lophodytes cucullatus*		6	1	3	2	2
Horned Grebe	*Podiceps auritus*		4	7	4		
House Finch	*Carpodacus mexicanus*		21			43	41
House Sparrow	*Passer domesticus*		61	182	75	17	54
Mallard	*Anas platyrhynchos*		31	65	106	38	31
Mourning Dove	*Zenaida macroura*		126	151	190	190	63
Northern Cardinal	*Cardinalis cardinalis*		13	19	22	12	30
Northern Harrier	*Circus cyaneus*		1				
Northern Mockingbird	*Mimus polyglottos*					1	
Northern Saw-whet Owl	*Aegolius acadicus*				1		
Northern Shrike	*Lanius excubitor*			2	1	1	
Pileated Woodpecker	*Dryocopus pileatus*		7	4	8	4	7
Pine Grosbeak	*Pinicola enucleator*			12		37	
Pine Siskin	*Spinus pinus*		22	30			286
Purple Finch	*Carpodacus purpureus*						9
Red-bellied Woodpecker	*Melanerpes carolinus*		1				
Red-breasted Nuthatch	*Sitta canadensis*		50	18	32	11	39
Red-tailed Hawk	*Buteo jamaicensis*				3		
Ring-billed Gull	*Larus delawarensis*		1				2
Ring-necked Pheasant	*Phasianus colchicus*		1				
Rock Pigeon	*Columba livia*		50	9	141	89	111
Rough-legged Hawk	*Buteo lagopus*		1				
Ruffed Grouse	*Bonasa umbellus*		4	5	9		3
Sharp-shinned Hawk	*Accipiter striatus*		1	1			
Snow Bunting	*Plectrophenax nivalis*			30			
Song Sparrow	*Melospiza melodia*				1		3
Tufted Titmouse	*Baeolophus bicolor*		36	32	29	45	48
unidentified accipiter	*Accipiter* sp.				1		
White-breasted Nuthatch	*Sitta carolinensis*		58	51	38	57	79
White-throated Sparrow	*Zonotrichia albicollis*				1		2
White-winged Crossbill	*Loxia leucoptera*						3
Wild Turkey	*Meleagris gallopavo*		12	73	1	54	83

Appendix B Table 7. All avian species detected during regional and on-site surveys, and their listing status. Status: E (endangered), T (threatened), SC (special concern), BCC (federal bird of conservation concern), HP (Partners in Flight High Priority), StW (Partners in Flight Species to Watch). Regional surveys: BBA (Breeding Bird Atlas [Foss 1994]), BBS (USGS Breeding Bird Survey), CBC (Christmas Bird Count), HMANA (HMANA survey at Little Round Top), and eBird (Cornell Lab of Ornithology and National Audubon Society's online checklist program). On-site surveys: Sp RAP (spring raptor survey), Fa RAP (fall raptor survey), BBS (breeding bird survey).

Common Name	Scientific name	NH Status	Federal Status	PIF Status	Regional surveys detected	On-site surveys detected
Alder Flycatcher	Empidonax alnorum				BBA, BBS, eBird	
American Bittern	Botaurus lentiginosus		BCC		BBA, BBS, eBird	
American Black Duck	Anas rubripes				BBA, BBS, CBC, eBird	
American Crow	Corvus brachyrhynchos				BBA, BBS, CBC, eBird	Sp RAP, Fa RAP, BBS
American Golden-Plover	Pluvialis dominica				eBird	
American Goldfinch	Spinus tristis				BBA, BBS, CBC, eBird	Sp RAP, Fa RAP
American Kestrel	Falco sparverius	SC			HMANA, BBA, BBS, eBird	Sp RAP, Fa RAP, BBS
American Pipit	Anthus rubescens	SC			eBird	
American Redstart	Setophaga ruticilla			HP	BBA, BBS, eBird	Fa RAP
American Robin	Turdus migratorius				BBA, BBS, CBC, eBird	Sp RAP, Fa RAP, BBS
American Tree Sparrow	Spizella arborea				CBC, eBird	
American Wigeon	Anas americana				eBird	
American Woodcock	Scolopax minor				BBS, eBird	
Bald Eagle	Haliaeetus leucocephalus	T	BCC	HP	HMANA, CBC, eBird	Sp RAP, Fa RAP
Baltimore Oriole	Icterus galbula				BBA, BBS, eBird	Sp RAP
Bank Swallow	Riparia riparia	SC		HP	BBA, BBS, eBird	
Barn Swallow	Hirundo rustica			HP	BBA, BBS, eBird	Sp RAP
Barred Owl	Strix varia				BBA, BBS, CBC, eBird	BBS
Bay-breasted Warbler	Setophaga castanea		BCC		eBird	
Belted Kingfisher	Megaceryle alcyon				BBA, BBS, CBC, eBird	
Black Scoter	Melanitta americana				eBird	
Bicknell's Thrush	Catharus bicknelli	SC	BCC	HP	BBA, eBird	
Black Vulture	Coragyps atratus				HMANA	
Black-and-white Warbler	Mniotilta varia				BBA, BBS, eBird	Sp RAP, BBS
Black-backed Woodpecker	Picoides arcticus				eBird	
Black-bellied Plover	Pluvialis squatarola				eBird	
Black-billed Cuckoo	Coccyzus erythropthalmus				BBA, BBS, eBird	
Blackburnian Warbler	Setophaga fusca			HP	BBA, BBS, eBird	BBS
Black-capped Chickadee	Poecile atricapillus				BBA, BBS, CBC, eBird	Sp RAP, Fa RAP, BBS
Black-headed Gull	Chroicocephalus ridibundus				eBird	
Blackpoll Warbler	Setophaga striata				BBA, eBird	BBS
Black-throated Blue Warbler	Setophaga caerulescens				BBA, BBS, eBird	Sp RAP, BBS
Black-throated Green Warbler	Setophaga virens				BBA, BBS, eBird	Sp RAP, BBS
Blue Jay	Cyanocitta cristata				BBA, BBS, CBC, eBird	Sp RAP, Fa RAP, BBS
Blue-gray Gnatcatcher	Polioptila caerulea				BBA, eBird	
Blue-headed Vireo	Vireo solitarius				BBA, BBS, eBird	Sp RAP, BBS
Blue-winged Warbler	Vermivora cyanoptera		BCC		eBird	
Bobolink	Dolichonyx oryzivorus				BBA, BBS, eBird	Sp RAP
Bohemian Waxwing	Bombycilla garrulus				CBC, eBird	
Bonaparte's Gull	Chroicocephalus philadelphia				eBird	
Boreal Chickadee	Poecile hudsonicus				eBird	
Broad-winged Hawk	Buteo platypterus				HMANA, BBA, BBS, eBird	Sp RAP, Fa RAP
Brown Creeper	Certhia americana				BBA, BBS, CBC, eBird	Fa RAP
Brown Thrasher	Toxostoma rufum			HP	BBA, BBS, eBird	
Brown-headed Cowbird	Molothrus ater				BBA, BBS, eBird	
Buff-breasted Sandpiper	Tryngites subruficollis		BCC		eBird	
Bufflehead	Bucephala albeola				eBird	
Canada Goose	Branta canadensis				BBS, CBC, eBird	Sp RAP, Fa RAP
Canada Warbler	Cardellina canadensis		BCC	HP	BBA, BBS, eBird	BBS
Cape May Warbler	Setophaga tigrina				eBird	BBS
Carolina Wren	Thryothorus ludovicianus				CBC, eBird	
Cedar Waxwing	Bombycilla cedrorum				BBA, BBS, CBC, eBird	Sp RAP, BBS
Chestnut-sided Warbler	Setophaga pensylvanica			HP	BBA, BBS, eBird	Sp RAP, BBS
Chimney Swift	Chaetura pelagica			HP	BBA, BBS, eBird	
Chipping Sparrow	Spizella passerina				BBA, BBS, eBird	
Clay-colored Sparrow	Spizella pallida				eBird	
Cliff Swallow	Petrochelidon pyrrhonota	SC		HP	BBA, BBS, eBird	
Common Goldeneye	Bucephala clangula				CBC, eBird	
Common Grackle	Quiscalus quiscula				BBA, BBS, eBird	
Common Loon	Gavia immer	T			CBC, eBird	
Common Merganser	Mergus merganser				CBC, eBird	
Common Nighthawk	Chordeiles minor	E		HP	BBS, eBird	
Common Raven	Corvus corax				BBA, BBS, CBC, eBird	Sp RAP, Fa RAP, BBS
Common Redpoll	Acanthis flammea				CBC, eBird	
Common Snipe	Gallinago gallinago				BBA, BBS	
Common Yellowthroat	Geothlypis trichas				BBA, BBS, eBird	Sp RAP, BBS

Common Name	Scientific name	NH Status	Federal Status	PIF Status	Regional surveys detected	On-site surveys detected
Connecticut Warbler	Oporornis agilis				eBird	
Cooper's Hawk	Accipiter cooperii			HP	HMANA, CBC, eBird	Sp RAP, Fa RAP
Dark-eyed Junco	Junco hyemalis				BBA, BBS, CBC, eBird	Sp RAP, Fa RAP, BBS
Double-crested Cormorant	Phalacrocorax auritus				eBird	
Downy Woodpecker	Picoides pubescens				BBA, BBS, CBC, eBird	Sp RAP, Fa RAP
Eastern Bluebird	Sialia sialis				BBA, BBS, eBird	Fa RAP
Eastern Kingbird	Tyrannus tyrannus				BBA, BBS, eBird	Sp RAP
Eastern Meadowlark	Sturnella magna	SC		HP	BBA, BBS, eBird	
Eastern Phoebe	Sayornis phoebe				BBA, BBS, eBird	Sp RAP
Eastern Towhee	Pipilo erythrophthalmus				BBA, BBS, eBird	
Eastern Whip-poor-will	Caprimulgus vociferus	SC		HP	BBS, eBird	
Eastern Wood-Pewee	Contopus virens				BBA, BBS, eBird	Sp RAP
European Starling	Sturnus vulgaris				BBA, BBS, CBC, eBird	
Evening Grosbeak	Coccothraustes vespertinus				BBS, CBC, eBird	
Field Sparrow	Spizella pusilla			HP	BBA, BBS, eBird	
Fish Crow	Corvus ossifragus				eBird	
Fox Sparrow	Passerella iliaca				eBird	
Golden Eagle	Aquila chrysaetos	E		HP	HMANA, eBird	
Golden-crowned Kinglet	Regulus satrapa				BBA, BBS, CBC, eBird	Sp RAP, Fa RAP, BBS
Grasshopper Sparrow	Ammodramus savannarum	T	BCC	HP	eBird	
Gray Catbird	Dumetella carolinensis				BBA, BBS, eBird	
Gray Jay	Perisoreus canadensis			StW	eBird	
Great Black-backed Gull					eBird	
Great Blue Heron	Ardea herodias				BBA, BBS, eBird	Sp RAP, BBS
Great Crested Flycatcher	Myiarchus crinitus				BBA, BBS, eBird	Sp RAP
Great Egret	Larus marinus				eBird	
Great Horned Owl	Bubo virginianus				eBird	
Greater Scaup	Aythya marila				eBird	
Greater Yellowlegs	Tringa melanoleuca				eBird	
Green Heron	Butorides virescens				BBS, eBird	
Green-winged Teal	Anas crecca				eBird	
Hairy Woodpecker	Picoides villosus				BBA, BBS, CBC, eBird	Sp RAP, Fa RAP, BBS
Hermit Thrush	Catharus guttatus				BBA, BBS, eBird	Sp RAP, BBS
Herring Gull	Larus argentatus				CBC, eBird	
Hooded Merganser	Lophodytes cucullatus				BBA, BBS, CBC, eBird	
Hooded Warbler	Setophaga citrina				eBird	
Horned Grebe	Podiceps auritus		BCC		CBC, eBird	
Horned Lark	Eremophila alpestris	SC	BCC		eBird	
House Finch	Carpodacus mexicanus				BBA, BBS, CBC, eBird	
House Sparrow	Passer domesticus				BBA, BBS, CBC, eBird	
House Wren	Troglodytes aedon				BBA, BBS, eBird	
Indigo Bunting	Passerina cyanea				BBA, BBS, eBird	
Killdeer	Charadrius vociferus				BBA, BBS, eBird	
Lapland Longspur	Calcarius lapponicus				eBird	
Least Flycatcher	Empidonax minimus			HP	BBA, BBS, eBird	Sp RAP, BBS
Least Sandpiper	Calidris minutilla				eBird	
Lesser Scaup	Aythya affinis				eBird	
Lesser Yellowlegs	Tringa flavipes		BCC		eBird	
Lincoln's Sparrow	Melospiza lincolnii				eBird	
Louisiana Waterthrush	Parkesia motacilla				BBA, BBS, eBird	
Magnolia Warbler	Setophaga magnolia				BBA, BBS, eBird	BBS
Mallard	Anas platyrhynchos				BBA, BBS, CBC, eBird	Sp RAP
Marsh Wren	Cistothorus palustris			HP	BBS, eBird	
Merlin	Falco columbarius			StW	HMANA, eBird	Fa RAP
Mourning Dove	Zenaida macroura				BBA, BBS, CBC, eBird	Sp RAP, Fa RAP, BBS
Mourning Warbler	Geothlypis philadelphia				BBS, eBird	Sp RAP, BBS
Mute Swan	Cygnus olor				eBird	
Nashville Warbler	Oreothlypis ruficapilla				BBA, BBS, eBird	BBS
Northern Cardinal	Cardinalis cardinalis				BBS, CBC, eBird	
Northern Flicker	Colaptes auratus			StW	BBA, BBS, eBird	Sp RAP
Northern Goshawk	Accipiter gentilis				HMANA, eBird	Sp RAP, Fa RAP
Northern Harrier	Circus cyaneus	E		HP	HMANA, BBS, CBC, eBird	Fa RAP
Northern Mockingbird	Mimus polyglottos				BBS, CBC, eBird	
Northern Parula	Setophaga americana				BBA, BBS, eBird	Sp RAP
Northern Pintail	Anas acuta				eBird	
Northern Rough-winged Swallow	Stelgidopteryx serripennis				BBA, BBS, eBird	
Northern Saw-whet Owl	Aegolius acadicus				BBA, CBC, eBird	
Northern Shrike	Lanius excubitor				CBC, eBird	
Northern Waterthrush	Parkesia noveboracensis				BBA, BBS, eBird	
Olive-sided Flycatcher	Contopus cooperi	SC	BCC	StW	BBA, BBS, eBird	

Common Name	Scientific name	NH Status	Federal Status	PIF Status	Regional surveys detected	On-site surveys detected
Orange-crowned Warbler	Oreothlypis celata				eBird	
Orchard Oriole	Icterus spurius		BCC		eBird	
Osprey	Pandion haliaetus	SC		HP	HMANA, eBird	Sp RAP, Fa RAP
Ovenbird	Seiurus aurocapilla				BBA, BBS, eBird	Sp RAP, BBS
Palm Warbler	Setophaga palmarum				eBird	
Peregrine Falcon	Falco peregrinus	T	BCC	HP	HMANA, eBird	
Philadelphia Vireo	Vireo philadelphicus				BBS, eBird	
Pied-billed Grebe	Podilymbus podiceps	T	BCC		BBA, BBS, eBird	
Pileated Woodpecker	Dryocopus pileatus				BBA, BBS, CBC, eBird	Sp RAP, Fa RAP, BBS
Pine Grosbeak	Pinicola enucleator				CBC, eBird	
Pine Siskin	Spinus pinus				BBA, CBC, eBird	BBS
Pine Warbler	Setophaga pinus				BBS, eBird	
Prairie Warbler	Setophaga discolor				BBA, BBS, eBird	
Purple Finch	Carpodacus purpureus				BBA, BBS, CBC, eBird	Sp RAP
Red Crossbill	Loxia curvirostra				BBS, eBird	
Red-bellied Woodpecker	Melanerpes carolinus				CBC, eBird	
Red-breasted Merganser	Mergus serrator				eBird	
Red-breasted Nuthatch	Sitta canadensis				BBA, BBS, CBC, eBird	Sp RAP, BBS
Red-eyed Vireo	Vireo olivaceus				BBA, BBS, eBird	Sp RAP, BBS
Red-necked Grebe	Podiceps grisegena				eBird	
Red-shouldered Hawk	Buteo lineatus				HMANA, BBA, BBS, eBird	Sp RAP
Red-tailed Hawk	Buteo jamaicensis				HMANA, BBA, BBS, CBC, eBird	Sp RAP, Fa RAP
Red-winged Blackbird	Agelaius phoeniceus				BBA, BBS, eBird	
Ring-billed Gull	Larus delawarensis				CBC, eBird	
Ring-necked Duck	Aythya collaris				eBird	
Ring-necked Pheasant	Phasianus colchicus				CBC	
Rock Pigeon	Columba livia				BBS, CBC, eBird	
Rose-breasted Grosbeak	Pheucticus ludovicianus				BBA, BBS, eBird	Sp RAP, BBS
Rough-legged Hawk	Buteo lagopus				HMANA, CBC	Fa RAP
Ruby-crowned Kinglet	Regulus calendula				BBS, eBird	
Ruby-throated Hummingbird	Archilochus colubris				BBA, BBS, eBird	
Ruddy Duck	Oxyura jamaicensis		BCC		eBird	
Ruffed Grouse	Bonasa umbellus				BBA, BBS, CBC, eBird	
Rusty Blackbird	Euphagus carolinus	SC	BCC	HP	BBS, eBird	
Sabine’s Gull	Xema sabini				eBird	
Sandhill Crane	Grus canadensis				eBird	
Sapsucker (3 species)	Sphyrapicus spp.				BBS	
Savannah Sparrow	Passerculus sandwichensis				BBA, BBS, eBird	Sp RAP
Scarlet Tanager	Piranga olivacea			HP	BBA, BBS, eBird	Sp RAP
Semipalmated Sandpiper	Calidris pusilla		BCC		eBird	
Sharp-shinned Hawk	Accipiter striatus			StW	HMANA, BBA, BBS, CBC, eBird	Sp RAP, Fa RAP
Snow Bunting	Plectrophenax nivalis				CBC, eBird	
Snow Goose	Chen caerulescens				eBird	
Solitary Sandpiper	Tringa solitaria		BCC		eBird	
Song Sparrow	Melospiza melodia			StW	BBA, BBS, CBC, eBird	Sp RAP
Spotted Sandpiper	Actitis macularius				BBS, eBird	
Spruce Grouse	Falcipennis canadensis	SC		HP	eBird	
Surf Scoter	Melanitta perspicillata				eBird	
Swainson's Thrush	Catharus ustulatus				BBA, BBS, eBird	BBS
Swamp Sparrow	Melospiza georgiana				BBA, BBS, eBird	
Tennessee Warbler	Oreothlypis peregrina				, eBird	Sp RAP
Tree Swallow	Tachycineta bicolor				BBA, BBS, eBird	Sp RAP
Tufted Titmouse	Baeolophus bicolor				BBS, CBC, eBird	
Tundra Swan	Cygnus columbianus				eBird	
Turkey Vulture	Cathartes aura				HMANA, BBA, BBS, eBird	Sp RAP, Fa RAP
unidentified accipiter					HMANA, CBC	Sp RAP, Fa RAP
unidentified buteo					HMANA	Sp RAP, Fa RAP
unidentified eagle					HMANA	
unidentified falcon					HMANA	
unidentified passerine						Sp RAP, Fa RAP, BBS
unidentified raptor					HMANA	Sp RAP, Fa RAP
unidentified swallow						Sp RAP
unidentified waterfowl						Sp RAP
Veery	Catharus fuscescens			HP	BBA, BBS, eBird	Sp RAP, BBS
Vesper Sparrow	Pooecetes gramineus	SC		HP	BBS, eBird	
Virginia Rail	Rallus limicola				eBird	
Warbling Vireo	Vireo gilvus				BBA, BBS, eBird	BBS
Western Kingbird	Tyrannus verticalis				eBird	
White-breasted Nuthatch	Sitta carolinensis				BBA, BBS, CBC, eBird	Sp RAP, Fa RAP
White-crowned Sparrow	Zonotrichia leucophrys				eBird	
White-throated Sparrow	Zonotrichia albicollis				BBA, BBS, CBC, eBird	Sp RAP, Fa RAP, BBS
White-winged Crossbill	Loxia leucoptera				CBC, eBird	

Common Name	Scientific name	NH Status	Federal Status	PIF Status	Regional surveys detected	On-site surveys detected
Wild Turkey	Meleagris gallopavo				BBS, CBC, eBird	Sp RAP, Fa RAP
Willow Flycatcher	Empidonax traillii				BBA, BBS, eBird	
Willow/Alder Flycatcher	Empidonax spp.				BBS eBird	
Wilson's Snipe	Gallinago delicata				eBird	
Wilson's Warbler	Cardellina pusilla				eBird	Sp RAP, BBS
Winter Wren	Troglodytes hiemalis				BBA, BBS, eBird	Sp RAP, BBS
Wood Duck	Aix sponsa				BBA, BBS, eBird	
Wood Thrush	Hylocichla mustelina		BCC	HP	BBA, BBS, eBird	Sp RAP
Yellow Warbler	Setophaga petechia				BBA, BBS, eBird	Sp RAP, BBS
Yellow-bellied Flycatcher	Empidonax flaviventris				BBA, BBS, eBird	
Yellow-bellied Sapsucker	Sphyrapicus varius				BBA, BBS, eBird	Sp RAP, BBS
Yellow-billed Cuckoo	Coccyzus americanus			StW	BBS, eBird	
Yellow-rumped Warbler	Setophaga coronata				BBA, BBS, eBird	Sp RAP, Fa RAP, BBS
Yellow-throated Vireo	Vireo flavifrons				BBA, BBS, eBird	

Appendix B Table 8. New Hampshire state-listed avian species, surveys in which they were identified, and their breeding habitat.

Species Common Name	Scientific Name	Surveys Identified	Breeding Habitat[3]
Endangered			
Common Nighthawk	*Chordeiles minor*	regional	barren areas with rocky substrate; rocky ridges, graveled rooftops
Golden Eagle	*Aquila chrysaetos*	regional	cliffs for nesting, large expanses of remote open land, abundant wetlands
Least Tern	*Sterna antillarum*		open beaches and vegetation-free islands, preferably with sand, shell or gravel substrates
Northern Harrier	*Circus cyaneus*	regional, on-site	open and semi-open habitat; dense stands of low woody plants near open grassland areas
Piping Plover[1]	*Charadrius melodus*		coastal beaches, sandflats at end of sandspits and barrier islands, gently sloping foredunes, sparsely vegetated dunes
Roseate Tern[2]	*Sterna dougallii*		small rocky or sandy islands, barrier beaches, and salt marshes (rarely on mainland)
Sedge Wren	*Cistothorus platensis*		wetlands dominated by sedges or grasses (wet hayfields, peat moss bogs, margins of ponds) with shrub cover
Upland Sandpiper	*Bartramia longicauda*		grassland habitats with a mix of short and tall grasses (airfields, blueberry barrens, mixed agricultural lands); taller structures for singing perches
Threatened			
American Three-toed Woodpecker	*Picoides tridactylus*		boreal and montane coniferous forests with abundant dead and dying trees
Bald Eagle	*Haliaeetus leucocephalus*	regional, on-site	large bodies of water with abundant fish and tall trees for nesting
Common Loon	*Gavia immer*	regional	undisturbed bodies of water with stable water levels
Common Tern	*Sterna hirundo*		rocky islands, barrier islands and salt marshes close to feeding areas and with protection from predators; bare ground with nearby vegetation
Grasshopper Sparrow	*Ammodramus savannarum*	regional	dry fields with sparse grasses and weeds, few shrubs and patches of bare ground; conspicuous song perches
Peregrine Falcon	*Falco peregrinus*	regional	ledges, cliffs near open landscapes (mountains, agricultural land, wide river valleys, lake shorelines, coastal areas)
Pied-billed Grebe	*Podilymbus podiceps*	regional	wetlands, especially ponds or slow portions of streams with dense stands of emergent vegetation; water depth at least 10 inches and emergent stem densities of at least 0.15 in^2/ft^2
Species of Special Concern			
American Kestrel	*Falco sparverius*	regional, on-site	generally open habitats; nest cavities in trees with diameter >12 inches; elevated hunting perches
American Pipit	*Anthus rubescens*	regional	alpine sedge meadow communities and fell fields; eroded turf, tussocks and titled rocks for nest protection
Arctic Tern	*Sterna paradisaea*		rocky, gravelly islands, barrier beaches, gravel bards and occasionally marshes and bogs
Bank Swallow	*Riparia riparia*	regional	stable, steep banks of sand, gravel or clay near open areas and a water source (preferably flowing water)
Bicknell's Thrush	*Catharus bicknelli*	regional	Stunted balsam fir-dominated forests on high elevation mountain slopes
Cerulean Warbler	*Dendroica cerulea*		hardwood forests including floodplains and uplands; found along major rivers or occasionally lakes with closed canopy and scattered tall trees; mesic forests on mountain slopes.
Cliff Swallow	*Petrochelidon pyrrhonota*	regional	vertical substrate with overhang for nesting, mud supply for nest construction, fresh water source, open foraging area
Common Gallinule	*Gallinula chloropus*		permanently flooded freshwater or brackish shallow ponds or deep marshes; robust, tall grass-like vegetation interspersed with pools and channels containing leafy plants
Eastern Meadowlark	*Sturnella magna*	regional	extensive open grassland with elevated song perches
Eastern Whip-poor-will	*Caprimulgus vociferus*	regional	areas of dry soils and open understory, especially in pine and oak woodlands
Golden-winged Warbler	*Vermivora chrysoptera*		bushy open areas, especially clearings in deciduous woodlands with saplings, forbs and grasses; avoids mountains
Horned Lark	*Eremophila alpestris*	regional	sparsely vegetated open areas (airports, gold courses, cemeteries)
Least Bittern	*Ixobrychus exilis*		freshwater or brackish marshes with scattered woody vegetation; cat-tail marshes
Nelson's Sharp-tailed Sparrow	*Ammodramus nelsoni*		salt marshes
Olive-sided Flycatcher	*Contopus cooperi*	regional	tall, exposed perches, typically near bogs, swamps, clearcuts or beaver ponds
Osprey	*Pandion haliaetus*	regional, on-site	large lakes, major river and coastal estuaries with dependable fisheries; elevated platforms or supracanopy trees
Purple Martin	*Progne subis*		open areas with relatively unobstructed views of the horizon (golf courses, lakeshores, open fields)
Rusty Blackbird	*Euphagus carolinus*	regional	spruce-fir and mixed spruce-fir-hardwood forest adjacent to streams, ponds, open wetlands at elevations between 1,000 and 4,000 feet
Saltmarsh Sharp-tailed Sparrow	*Ammodramus caudacutus*		salt marshes
Seaside Sparrow	*Ammodramus maritimus*		salt marshes (both high and low marsh)
Sora	*Porzana carolina*		large marshes and wetlands with abundant emergent vegetation
Spruce Grouse	*Falcipennis canadensis*	regional	dense coniferous forests and low-elevation bogs with forest openings, trees with branches to the ground and sparse ground cover
Vesper Sparrow	*Pooecetes gramineus*	regional	dry, open grassy areas with patches of bare ground and elevated perching areas (old field, cop and hayfields, cemeteries and airports)
Willet	*Tringa semipalmata*		salt marshes (cordgrass dominated)

[1] Federally-listed as threatened
[2] Federally-listed as endangered
[3] Breeding habitat information from DeGraff and Yamasaki 2001 and New Hampshire Fish and Game Department 2012.

Appendix B Table 9a. Publicly available raptor fatality results at operational wind projects in the eastern U.S. from 2007-2012

Massachusetts	**1**
osprey	1
Maine	**1**
red-tailed hawk	1
New York	**38**
American kestrel	2
broad-winged hawk	3
Cooper's hawk	1
red-tailed hawk	25
sharp-shinned hawk	6
turkey vulture	1
New Hampshire	**1**
red-tailed hawk	1
Vermont	**1**
sharp-shinned hawk	1
Maryland	**3**
turkey vulture	2
unidentified raptor	1
Pennsylvania	**0**
Tennessee	**0**
West Virginia	**6**
red-tailed hawk	1
sharp-shinned hawk	1
turkey vulture	4
TOTAL	**51**

Appendix B Table 9b. Projects with raptor fatality results included in Table 9a

Project	Study Year (s)	No. turbines	Reference
Altona, New York	2010	65	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2011. Annual Report for the Noble Altona Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2010. Prepared for Noble Environmental Power, LLC.
Bliss, NY	2008	67	Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, J. Quant, D. Pursell. 2009. Annual Report for the Noble Bliss Windpark, LLC. Postconstruction Bird and Bat Fatality Study – 2008. Prepared by Curry and Kerlinger, LLC.
Bliss, NY	2009	67	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2010. Annual Report for the Noble Bliss Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC.
Buffalo Mtn, Tennessee	2005	18	Fiedler, J.K., T.H. Henry, R.D. Tankersley, and C.P. Nicholson 2007. Results of Bat and Bird Mortality Monitoring at the Expanded Buffalo Mountain Windfarm, 2005 June 28, 2007. Prepared for Tennessee Valley Authority.
Casselman, Somerset Cty, PA	2008	23	Arnett, E.B., M. Schirmacher, M.P. Huso, J.P. Hayes. 2010. Effectiveness of changing wind turbine cut-in speed to reduce bat fatalities at wind facilities. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA.
Casselman, Somerset Cty, PA	2009	23	Arnett, E.B., M. Schirmacher, M.P. Huso, J.P. Hayes. 2010. Effectiveness of changing wind turbine cut-in speed to reduce bat fatalities at wind facilities. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA.
Chateaugay, NY	2010	71	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2011. Annual Report for the Noble Chateaugay Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2010. Prepared for Noble Environmental Power, LLC.
Clinton, NY	2008	67	Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, J. Histed, and J. Meacham. 2009. Annual Report for the Noble Clinton Windpark, LLC. Postconstruction Bird and Bat Fatality Study – 2008. Prepared by Curry and Kerlinger, LLC.
Clinton, NY	2009	67	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2010. Annual Report for the Noble Clinton Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC.
Cohocton and Dutch Hill, NY	2009	50	Stantec Consulting. 2009. Cohocton and Dutch Hill Wind Farms Year 1 Post-Construction Monitoring Report, 2009 for the Cohocton and Dutch Hill Wind Farms. Prepared for Canandaigua Power Partners, LLC and Canandaigua Power Partners II, LLC.
Cohocton and Dutch Hill, NY	2010	50	Stantec Consulting. 2011. Cohocton and Dutch Hill Wind FarmsYear 2 Post-Construction Monitoring Report, 2010 for the Cohocton and Dutch Hill Wind Farms In Cohocton, New York. Prepared for Canandaigua Power Partners, LLC and Canandaigua Power Partners II, LLC.
Criterion, MD	2012	28	Young, D., C. Nations, M. Lout, and K. Bay. 2013. 2012 Post-Construction Monitoring Study Criterion Wind Project Garrett County, Maryland, April-November 2012. Technical report prepared for: Criterion Power Partners, LLC, Oakland, Maryland. Prepared by: Western EcoSystems Technology, Inc., Cheyenne, Wyoming and Waterbury, Vermont.
Ellenburg, NY	2008	54	Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, A. Fuerst, and C. Hansen. 2009. Annual Report for the Noble Ellenburg Windpark, LLC. Postconstruction Bird and Bat Fatality Study – 2008. Prepared by Curry and Kerlinger, LLC.
Ellenburg, NY	2009	54	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2010. Annual Report for the Noble Ellenburg Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC.
Granite Reliable, NH	2012	33	Curry and Kerlinger. 2013. Post-construction mortality study Granite Reliable Power Wind Park, Coos County, New Hampshire, Annual Report January 2013. Prepared for Granite Reliable Power, LLC.
Groton, NH	2013	24	*West 2013 preliminary data*
Hardscrabble, NY	2012	37	West. 2013. 2012 Post-Construction Study and AnaBat Study Hardscrabble Wind Project Herkimer County, New York April 15 – October 15, 2012. Prepared for: Iberdrola Renewables, LLC.
Howard, NY	2012	27	West. 2013. 2012 Post-Construction Monitoring Studies for the Howard Wind Projgect Steuben County, New York. Prepared for Howard Wind, LLC.
Kibby Mountain, ME	2011	44	Stantec Consulting. 2011. 2011 Post-Construction Monitoring Report Kibby Wind Power Project, Franklin County, Maine. Prepared for TransCanada Hydro Northeast, Inc.
Lempster, NH	2009	12	Tidhar, D. 2009. Post-construction Wildlife Monitoring Study; Study Plan and Spring 2009 Interim Report. Lempster Wind Project, Sullivan County, New Hampshire. Prepared for Lempster Wind LLC Lempster Wind Technical Advisory Committee, Iberdrola Renewables. Prepared by Western EcoSystems Technology, Inc. Waterbury, VT.
Lempster, NH	2010	12	Tidhar, D., W. Tidhar, L. McManus, and Z. Courage. 2011. 2010 Post-Construction Fatality Surveys for Lempster Wind Project. Prepared for Lempster Wind, LLC.
Maple Ridge, NY	2006	120	Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2007. Annual Report for the Maple Ridge Wind Power Project Postconstruction Bird and Bat Fatality Study – 2006 FINAL REPORT June 25, 2007. Prepared for PPM Energy and Horizon Energy and Technical Advisory Committee (TAC for the Maple Ridge Project Study).
Maple Ridge, NY	2007	195	Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2008. Annual Report for the Maple Ridge Wind Power Project Postconstruction Bird and Bat Fatality Study – 2007 (May 2, 2008). Prepared for PPM Energy and Horizon Energy and Technical Advisory Committee (TAC for the Maple Ridge Project Study).
Maple Ridge, NY	2008	195	Jain, A., and P. Kerlinger, R. Curry, L. Slobodnik, and M. Lehman. 2009. Annual Report for the Maple Ridge Wind Power Project Postconstruction Bird and Bat Fatality Study – 2008 (May 14, 2009).
Maple Ridge, NY	2012	195	Tidhar, D., J. Ritzert, M. Sonnenberg, M. Lout, and K. Bay. 2013. 2012 Post-construction Fatality Monitoring Study for the Maple Ridge Wind Farm, Lewis County, New York. Final Report: July 12 – October 15, 2012. Prepared for EDP Renewables North America by Western EcoSystems Technology, Inc. NE/Mid-Atlantic Branch, Waterbury, Vermont.
Mars Hill, ME	2007	28	Stantec Consulting. 2008. 2007 Spring, Summer, and Fall Post 2007 Spring, Summer, and Fall Post-construction Bird and Bat Mortality Study at the Mars Hill Wind Farm, Maine. Unpublished report prepared for UPC Wind Management, LLC.
Mars Hill, ME	2008	28	Stantec Consulting. 2009. Post-construction monitoring at the Mars Hill Wind Farm, Maine – Year 2 2008. Prepared for First Wind Management, LLC.

Project	Study Year (s)	No. turbines	Reference
Meyersdale, Pennsylvania	2004	20	Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn. 2005. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. Bats and Wind Energy Cooperative.
MMA turbine, Massachusetts	2006	1	Vlietstra, L.S. 2007. Potential Impact of the Massachusetts Maritime Academy Wind Turbine on Common and Roseate Terns
Mount Storm, West Virginia	2008	82	Young, D.P., W.P. Erickson, K. Bay, S. Normani, W. Tidhar. 2009. Mount Storm Wind Energy Facility, Phase 1: Post-construction Avian and Bat Monitoring. Prepared for: NedPower Mount Storm, LLC.
Mount Storm, West Virginia	2010	82	Young, D.P., S. Nomani, W. Tidhar, and K. Bay. 2010. Mount Storm Wind Energy Facility Post-construction Avian and Bat Monitoring, July-October 2010. Prepared for NedPower Mount Storm, LLC.
Mountaineer, West Virginia	2003	44	Kerns, J., and P. Kerlinger. 2004. A study of bird and bat collision fatalities at the Mountaineer Wind Energy Center, Tucker County, West Virginia, USA: annual report for 2003. <http://www.responsiblewind.org/docs/MountaineerFinalAvianRpt3-15-04PKJK.pdf>. (Accessed 30 September 2007).
Mountaineer, West Virginia	2004	44	Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn. 2005. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. Bats and Wind Energy Cooperative.
Munnsville, NY	2008	23	Stantec Consulting. 2009. Post-construction monitoring at the Munnsville Wind Farm, New York, 2008. Prepared for E.ON Climate and Renewables.
Record Hill, ME	2012	22	Stantec Consulting. 2012. Record Hill Wind Project Post-Construction Monitoring Report, 2012. Prepared for Record Hill Wind, LLC.
Rollins, ME	2012	40	Stantec Consulting. 2012. RollinsWind Project Post-Construction Monitoring Report, 2012. Prepared for First Wind, LLC.
Searsburg, VT	1997	11	Kerlinger, P. 2002. An Assessment of the Impacts of Green Mountain Power Corporation's Wind Power Facility on Breeding and Migrating Birds in Searsburg, Vermont. Prepared for the Vermont Department of Public Service Montpelier, Vermont. Subcontractor report for the National Renewable Energy Laboratory NREL/SR-500-28591.
Sheffield, Vermont	2012	16	Martin, C., E. Arnett, M. Wallace. 2013. Evaluating Bird and Bat Post-Construction Impacts at the Sheffield Wind Facility, Vermont 2012 Annual Report. Prepared for Bat Conservation International and First Wind.
Somerset County, Pennsylvania	2000	8	Kerlinger, P. 2006. Supplement to the Phase I Avian Risk Assessment and Breeding Bird Study for the Deerfield Wind Project, Bennington County, Vermont. Prepared for Deerfield Wind, LLC.
Steel Winds I & II, NY	2012	14	Stantec. 2013. Steel Winds I and II Post-Construction Monitoring Report, 2012. Prepared for First Wind Management, LLC.
Stetson I, ME	2009	38	Stantec Consulting. 2009. Stetson I Mountain Wind Project Year 1 Post-Construction Monitoring Report, 2009, for the Stetson Mountain Wind Project. Prepared for First Wind Management, LLC.
Stetson I, ME	2011	38	Normandeau Associates. 2010. Year 3 Post-construction avian and bat casualty monitoring at the Stetson I Wind Farm. Prepared for First Wind, LLC.
Stetson II, ME	2010	17	Normandeau Associates. 2010. Stetson Mountain II Wind Project Year 1 Post-Construction. Prepared for First Wind, LLC. Avian and Bat Mortality Monitoring Study T8 R4 NBPP, Maine
Stetson II, ME	2010	17	Stantec Consulting. 2012. Stetson II Wind Project Post-Construction Monitoring Report, 2012. Prepared for First Wind, LLC.
Wethersfield, NY	2010	84	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K., Harte, A. 2011. Annual Report for the Noble Wethersfield Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2010. Prepared for Noble Environmental Power, LLC.

Appendix B Table 10. Available bird and bat mortality data reported at existing wind farms in the eastern, U.S.

Site	Habitat type (# turbines)	Dates surveyed	Search interval	# BATS found during surveys (incidental)	Estimated BATS/turbine/period (total)	# BIRDS found during surveys (incidental)	Estimated BIRDS/turbine/period (total)	Reference
Massachuesetts								
MMA turbine, Massachusetts	coastal (1)	April 24 - November 30, 2006	4-12 searches per week	0	n/a	3	2.15 (2.15)	Vlietstra, L.S. 2007. Potential Impact of the Massachusetts Maritime Academy Wind Turbine on Common and Roseate Terns
Maryland								
Criterion, MD	forested ridgeline (28)	April 1 to November 15, 2012	weekly at 50%	82	19.5 (546)	28	5.47 (153)	Young, D., C. Nations, M. Lout, and K. Bay. 2013. 2012 Post-Construction Monitoring Study Criterion Wind Project Garrett County, Maryland, April-November 2012. Technical report prepared for: Criterion Power Partners, LLC, Oakland, Maryland. Prepared by: Western EcoSystems Technology, Inc., Cheyenne, Wyoming and Waterbury, Vermont.
Maine								
Kibby Mountain, Maine	forested ridgeline (44)	May 2 to June 20; July 11 to October 14, 2011	22 3 times every 2 wks	6 (3)	spring: (0); fall: 0.37 (16)	17 (4)	spring: 0.72 (32); fall: 0.29 (12)	Stantec Consulting. 2011. 2011 Post-Construction Monitoring Report Kibby Wind Power Project, Franklin County, Maine. Prepared for TransCanada Hydro Northeast, Inc.
Mars Hill, Maine	forested ridgeline (28)	April 23-June 3, July 15-Sept 23, 2007	2 of 28 daily, 28 of 28 weekly, seasonal dog searches	22 (2)	0.43-4.4 (12.1-122.5)	19 (3)	0.44-2.5 (27-69)	Stantec Consulting. 2008. Spring, Summer, and Fall Post-construction Bird and Bat Mortality Study at the Mars Hill Wind Farm, Maine. Unpublished report prepared for UPC Wind Management, LLC.
Mars Hill, Maine	forested ridgeline (28)	April 19 - June 6, July 15-Oct 8, 2008	28 of 28 weekly, seasonal dog searches	5 (0)	0.17-0.68 (5-19)	17(4)	2.4-2.65 (57-74)	Stantec Consulting. 2009. Post-construction Monitoring at the Mars Hill Wind Farm, Maine – Year 2. Unpublished report prepared for First Wind Management, LLC.
Record Hill, Maine	forested ridgeline (22)	April 15 to June 7 and July 7 to October 15, 2012	22 3 times every 2 wks	44 (0)	6.78 (150) [4]	46 (7)	8.46 (187) [4]	Stantec Consulting. 2012. Record Hill Wind Project Post-Construction Monitoring Report, 2012. Prepared for Record Hill Wind, LLC.
Rollins, Maine	forested ridgeline (40)	April 15 to October 15, 2012	20 weekly	2 (0)	0.18 (7.2) [4]	9 (7)	2.94 (118) [4]	Stantec Consulting. 2012. RollinsWind Project Post-Construction Monitoring Report, 2012. Prepared for First Wind, LLC.
Stetson Mountain I, Maine	forested ridgeline (38)	April 20 to Oct 21, 2009	19 weekly	5 (0)	2.11 (80)	30 (9)	4.03 (153)	Stantec Consulting. 2010. Stetson I Mountain Wind Project, Year 1 Post-Construction Monitoring Report, 2009. Prepared for First Wind Management, LLC.
Stetson Mountain I, Maine	forested ridgeline (38)	April 18 to October 21, 2011	19 weekly	4 (0)	0.43 (16)	7 (0)	1.77 (67)	Normandeau Associates. 2010. Year 3 Post-construction avian and bat casualty monitoring at the Stetson I Wind Farm. Prepared for First Wind, LLC.
Stetson Mountain II, Maine	forested ridgeline (17)	April 19 to Oct 15, 2010	17 weekly	14 (0)	2.48 (42.12)	11 (0)	2.14 (36.41)	Normandeau Associates. 2010. Stetson Mountain II Wind Project Year 1 Post-Construction Avian and Bat Mortality Monitoring. Prepared for First Wind, LLC.
Stetson Mountain II, Maine	forested ridgeline (17)	April 15 to October 15, 2012	17 weekly	4 (0)	2.06 (36) [4]	5 (0)	2.83 (49) [4]	Stantec Consulting. 2012. Stetson II Wind Project Post-Construction Monitoring Report, 2012. Prepared for First Wind, LLC.
New Hampshire								
Granite Reliable, Coos Cty, NH	forested ridgeline (33)	April 22 - October 27, 2012	13 weekly thru Aug 18, 23 weekly thru Oct 27	2 (1)	2.6-3.0 (86-99) [6]	1	2.0-2.8 (66-92) [6]	Curry and Kerlinger. 2013. Post-construction mortality study Granite Reliable Power Wind Park, Coos County, New Hampshire, Annual Report January 2013. Prepared for Granite Reliable Power, LLC.
Groton, NH	forested ridgeline (24)	April 15 - October 31, 2013	24 weekly	18	n/a	23	n/a	*West 2013 preliminary data*
Lempster, NH	forested ridgeline (12)	April 15-June 1; July 15-Oct 31, 2009	4 daily	10 (2)	spring: 0.58 (7); fall: 5.51 (66)	9 (4)	spring: 0.80 (10); fall: 5.95 (71)	Tidhar, D., W. Tidhar, and M. Sonnenberg. 2010. Post-Construction Fatality Surveys for Lempster Wind Project. Prepared for Lempster Wind, LLC.
Lempster, NH	forested ridgeline (12)	April 15-June 1; July 15-Oct 31, 2010	12 weekly	14 (5)	spring (0); fall 7.13 (86)	11 (0)	spring: 1.16 (14); fall: 4.12 (49)	Tidhar, D., W. Tidhar, L. McManus, and Z. Courage. 2011. 2010 Post-Construction Fatality Surveys for Lempster Wind Project. Prepared for Lempster Wind, LLC.
New York								

Site	Habitat type (# turbines)	Dates surveyed	Search interval	# BATS found during surveys (incidental)	Estimated BATS/turbine/period (total)	# BIRDS found during surveys (incidental)	Estimated BIRDS/turbine/period (total)	Reference
Altona, New York	primarily woodlots (65)	April 26 to October 15, 2010	22 weekly, 8 daily from July 18 to Sept 18	24 (7)	daily: 6.51 (423); weekly: 3.87 (252)	14 (6)	daily: 1.55 (101); weekly: 2.76 (180)	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2011. Annual Report for the Noble Altona Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2010. Prepared for Noble Environmental Power, LLC.
Bliss, New York	agricultural, woodland (67)	April 21 to Nov 14, 2008	8 daily, 8 every 3-days, 7 weekly	74 (15)	daily: 7.58 (508); 3-day:14.66 (983); weekly: 13.01 (872)	20 (7)	daily: 4.30 (288); 3-day: 0.66 (44); weekly: 0.74 (50)	Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, J. Quant, D. Pursell. 2009. Annual Report for the Noble Bliss Windpark, LLC. Postconstruction Bird and Bat Fatality Study – 2008. Prepared by Curry and Kerlinger, LLC.
Bliss, New York	agricultural, woodland (67)	April 15 to November 15, 2009	8 daily, 15 weekly	36 (0)	daily: 8.24 (552); weekly: 4.46 (299)	25 (7)	daily: 4.45 (298); weekly: 2.87 (192)	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2010. Annual Report for the Noble Bliss Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC.
Chateaugay, NY	agricultural, woodlots (71)	April 26 to Oct 15, 2010	24 weekly	22 (7)	3.66 (260)	19 (9)	2.40 (170)	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2011. Annual Report for the Noble Chateaugay Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2010. Prepared for Noble Environmental Power, LLC.
Clinton, New York	agricultural, woodland (67)	April 26 to October 13, 2008	8 daily, 8 every 3-days, 7 weekly	39 (14)	daily: 5.45 (365); 3-day: 4.81 (322); weekly: 3.76 (252)	14 (9)	daily: 1.43 (956); 3-day: 3.26 (218); weekly: 2.48 (166)	Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, J. Histed, and J. Meacham. 2009. Annual Report for the Noble Clinton Windpark, LLC. Postconstruction Bird and Bat Fatality Study – 2008. Prepared by Curry and Kerlinger, LLC.
Clinton, New York	agricultural, woodland (67)	April 15 to November 15, 2009	8 daily, 15 weekly	36 (6)	daily: 9.72 (651); weekly: 5.16 (3.46)	16 (8)	daily: 1.50 (101); weekly: 1.76 (118)	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2010. Annual Report for the Noble Clinton Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC.
Cohocton and Dutch Hill, NY	agricultural, woodland (50)	April 15 to Nov 15, 2009	5 daily, 12 weekly	62 (7)	daily: 40.4 (2002); weekly: 13.8 (804)	15 (3)	2.9 - 4.7 (147-235)	Stantec Consulting. 2010. Cohocton and Dutch Hill Wind FarmsYear 1 Post-Construction Monitoring Report, 2009 for the Cohocton and Dutch Hill Wind Farms In Cohocton, New York. Prepared for Canandaigua Power Partners, LLC and Canandaigua Power Partners II, LLC.
Cohocton and Dutch Hill, NY	agricultural, woodland (50)	April 26 to October 22, 2010	17 weekly except when 12 weekly and 5 daily from July 15-Sept 17	63 (5)	daily: 25.62 (1281); weekly A): 5.04 (252); weekly B): 10.44 (522)	9 (1)	daily: 2.06 (103); weekly 1: 0.82 (41); weekly 2: 1.16 (58)	Stantec Consulting. 2011. Cohocton and Dutch Hill Wind FarmsYear 2 Post-Construction Monitoring Report, 2010 for the Cohocton and Dutch Hill Wind Farms In Cohocton, New York. Prepared for Canandaigua Power Partners, LLC and Canandaigua Power Partners II, LLC.
Ellenburg, New York	agricultural, woodland (54)	April 28 to Oct 13, 2008	6 daily, 6 every 3-days, 6 every 7-days	34 (25)	daily: 8.17 (441); 3-day: 6.94 (375); weekly: 4.19 (226)	12 (10)	daily: 2.09 (113); 3-day: 1.37 (74); weekly: 1.18 (64)	Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, A. Fuerst, and C. Hansen. 2009. Annual Report for the Noble Ellenburg Windpark, LLC. Postconstruction Bird and Bat Fatality Study – 2008. Prepared by Curry and Kerlinger, LLC.
Ellenburg, New York	agricultural, woodland (54)	April 15 to November 15, 2009	6 daily, 12 weekly	28 (4)	daily: 8.01 (433); weekly: 3.70 (200)	19 (2)	daily: 5.69 (307); weekly: 2.29 (124)	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2010. Annual Report for the Noble Ellenburg Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC.
Hardscrabble, New York	agricultural/woodland (37)	April 15 to October 15, 2012	12 daily (12 weekly supplemental)	171 (7)	21.34 (790)	48 (6)	6.86 (254)	West/Jason P. Ritzert, Rhett Good, and Shay Howlin. 2013. 2012 Post-Construction Study and AnaBat Study Hardscrabble Wind Project Herkimer County, New York April 15 – October 15, 2012. Prepared for: Iberdrola Renewables, LLC.
Howard, New York	agricultural/woodland (27)	April 15-Nov 15, 2012	5 daily, 5 weekly	138 (10)	20.09 (542) [5]	16 (standard and incidental combined)	2.5 (67.5[5]	West. 2013. 2012 Post-Construction Monitoring Studies for the Howard Wind Projgect Steuben County, New York. Prepared for Howard Wind, LLC.
Maple Ridge, New York	woodland, grassland, agricultural (120)	June 17 - Nov 15, 2006	10 every 3-days, 30 7-days, 10 daily	326 (58)	11.39-20.31 (1367-2437.2)	123 (15)	3.10-9.48 (372-1138)	Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2007. Annual report for the Maple Ridge wind power project post-construction bird and bat fatality study—2006. Annual report prepared for PPM Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA. http://www.wind-watch.org/documents/wp-content/uploads/maple_ridge_report_2006_final.pdf Accessed 1 December 2007.
Maple Ridge, New York	woodland, grassland, agricultural (195)	April 30 - Nov 14, 2007	64 weekly	202 (81)	15.54-18.53 (3030-3614)	64 (32)	5.67-6.31 (1106-1230)	Jain, A. P. Kerlinger, R. Curry, and L. Slobodnik. 2008. Annual report for the Maple Ridge wind power project post-construction bird and bat fatality study—2007. Annual report prepared for PPM Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA.
Maple Ridge, New York	woodland, grassland, agricultural (195)	April 15 - Nov 9, 2008	64 weekly	140 (76)	8.18 - 8.92 (1595-1739)	74 (23)	3.42-3.76 (667-733)	Jain, A. P. Kerlinger, R. Curry, and L. Slobodnik. 2009. Annual report for the Maple Ridge wind power project post-construction bird and bat fatality study—2007. Annual report prepared for PPM Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA.
Maple Ridge, New York	woodland, grassland, agricultural (195)	July 12 - October 15, 2012	weekly at 105 small plot and 5 large plots	68 (2)[5]	13.38 (2609)	11	n/a	Tidhar, D., J. Ritzert, M. Sonnenberg, M. Lout, and K. Bay. 2013. 2012 Post-construction Fatality Monitoring Study for the Maple Ridge Wind Farm, Lewis County, New York. Final Report: July 12 – October 15, 2012. Prepared for EDP Renewables North America by Western EcoSystems Technology, Inc. NE/Mid-Atlantic Branch, Waterbury, Vermont.

Site	Habitat type (# turbines)	Dates surveyed	Search interval	# BATS found during surveys (incidental)	Estimated BATS/turbine/period (total)	# BIRDS found during surveys (incidental)	Estimated BIRDS/turbine/period (total)	Reference
Munnsville, New York	agricultural forested uplands (23)	April 15-Nov 15, 2008	12 of 23 weekly, seasonal dog searches	9 (1)	0.70-2.90 (16-67)	7 (3)	1.71-2.22 (39-51)	Stantec Consulting. 2009. Post-construction monitoring at the Munnsville Wind Farm, New York, 2008. Prepared for E.ON Climate and Renewables.
Steel Winds I & II, NY	Lake Erie shoreline (14)	March 10 to May 31, July 15 to Nov 20, 2012	7 weekly	18 (1)	5.83 (82)[4]	6 (5)	3.97 (56)****	Stantec Consulting. 2013. Steel Winds I and II Post-Construction Monitoring Report, 2012. Prepared for First Wind Management, LLC
Wethersfield, NY	agricultural, woodlots (84)	April 15 to Oct 15, 2010	28 weekly	62 (13)	24.45 (2054)	11 (7)	2.55 (214)	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K., Harte, A. 2011. Annual Report for the Noble Wethersfield Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2010. Prepared for Noble Environmental Power, LLC.
Pennsylvania								
Casselman, Somerset Cty, PA	forested ridge, grassland mine ridge (23)	July 27 - October 9, 2008	22 daily	32 [3]	24.2 (557)	N/A	N/A	Arnett, E.B., M. Schirmacher, M.P. Huso, J.P. Hayes. 2010. Effectiveness of changing wind turbine cut-in speed to reduce bat fatalities at wind facilities. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA.
Casselman, Somerset Cty, PA	forested ridge, grassland mine ridge (23)	July 26 - October 8, 2009	22 daily	39 [3]	17.4 (400)	N/A	N/A	Arnett, E.B., M. Schirmacher, M.P. Huso, J.P. Hayes. 2010. Effectiveness of changing wind turbine cut-in speed to reduce bat fatalities at wind facilities. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA.
Meyersdale, Pennsylvania	forested ridgeline (20)	Aug 2 - Sept 13, 2004	10 daily, 10 weekly	262 (37)	25 (400-660)	13 (4)	n/a	Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn. 2005. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. Bats and Wind Energy Cooperative.
Somerset County, Pennsylvania	agricultural (8)	2000 (12 months)	n/a	0	n/a	0	n/a	Kerlinger, P. 2006. Supplement to the Phase I Avian Risk Assessment and Breeding Bird Study for the Deerfield Wind Project, Bennington County, Vermont. Prepared for Deerfield Wind, LLC.
Tennessee								
Buffalo Mtn, Tennessee	reclaimed mine on ridge (18)	April - Dec 10, 2005	18 of 18 every week, every 2 weeks, or every 2-5 days	243 (14)	63.9 (1,149)	9 (2)	1.8 (112)	Fiedler, J.K., T.H. Henry, R.D. Tankersley, and C.P. Nicholson 2007. Results of Bat and Bird Mortality Monitoring at the Expanded Buffalo Mountain Windfarm, 2005 June 28, 2007. Prepared for Tennessee Valley Authority.
Vermont								
Searsburg, Vermont	forested (11)	June 30 - Oct 18, 1997	11 total (4 per search) 2 to 6 days per month	0	n/a	0	n/a	Kerlinger, P. 2002. An Assessment of the Impacts of Green Mountain Power Corporation's Wind Power Facility on Breeding and Migrating Birds in Searsburg, Vermont. Prepared for the Vermont Department of Public Service Montpelier, Vermont. Subcontractor report for the National Renewable Energy Laboratory NREL/SR-500-28591.
Sheffield, Vermont	forested ridgeline (16)	April 1 – Oct 31, 2012	daily at 50% April-June, Oct; 100% July, Aug, Sept	87	14.65 (235)	35	13.17 (211)	Martin, C., E. Arnett, M. Wallace. 2013. Evaluating Bird and Bat Post-Construction Impacts at the Sheffield Wind Facility, Vermont 2012 Annual Report. Prepared for Bat Conservation International and First Wind.
West Virginia								
Mount Storm, West Virginia	forested ridgeline (82)	July 18 - Oct 17, 2008	18 weekly, 9 daily	182 (27)	daily: 24.21 (1985) weekly: 7.76 (636)	29 (8)	2.41-3.81 (198-312)	Young, D.P., W.P. Erickson, K. Bay, S. Normani, W. Tidhar. 2009. Mount Storm Wind Energy Facility, Phase 1: Post-construction Avian and Bat Monitoring. Prepared for: NedPower Mount Storm, LLC.
Mount Storm, West Virginia	forested ridgeline (82)	July-October, 2010	25 daily	308 (73)	22.39 (1836)	36 (11)	2.77 (227)	Young, D.P., S. Nomani, W. Tidhar, and K. Bay. 2010. Mount Storm Wind Energy Facility Post-construction Avian and Bat Monitoring, July-October 2010. Prepared for NedPower Mount Storm, LLC.
Mountaineer, West Virginia	forested ridgeline (44)	April 4 - Nov 11, 2003	2x per week	475	47.53 (2092)	69 [1]	4.04 (178 + 33 due to substation lighting)	Kerns, J., and P. Kerlinger. 2004. A study of bird and bat collision fatalities at the Mountaineer Wind Energy Center, Tucker County, West Virginia, USA: annual report for 2003. <http://www.responsiblewind.org/docs/MountaineerFinalAvianRpt3-15-04PKJK.pdf>. (Accessed 30 September 2007).
Mountaineer, West Virginia	forested ridgeline (44)	July 31- Sept 11, 2004	22 daily, 22 weekly	398 (68)	38 (1364-1980)	15 (n/a)	n/a	Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn. 2005. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. Bats and Wind Energy Cooperative.
1 33 birds found on May 23, 2003 at turbines near a substation and at substation associated with sodium vapor lights.								
2 Results of spring interim report, study period April 20 to June 1.								
3 Fresh bats found at curtailment treatment turbines reported only.								
4 Based on the Huso fatality estimator not including search area corrections.								
5 Included incidental carcasses in estimates of fatality.								
6 Based search area corrections on distribution of carcasses found at the Maple Ridge Wind Project, New York.								

Appendix B Table 11. Summary of available avian spring radar survey results conducted at proposed (pre-construction) US wind power facilities in eastern US, using X-band mobile radar systems (2004-present).

Project Site	Number of Survey Nights	Number of Survey Hours	Landscape	Average Passage Rate (t/km/hr)	Range in Nightly Passage Rates	Average Flight Direction	Average Flight Height (m)	(Turbine Ht) % Targets Below Turbine Height	Reference
Spring 2005									
Alabama, Genesee Cty, NY	40	n/a	Agricultural plateau	111	n/a	35	413	(125 m) 14%	Young, D. P., C. S. Nations, V. K. Poulton, J. Kerns. 2007. Avian and Bat Studies for the Proposed Alabama Ledge Wind Project, Genesee County, New York. Final Report prepared by WEST, Inc. for Horizon Wind Energy.
Noble C/E/A, Clinton Cty, NY	40	n/a	Great Lakes plain/ADK foothills	110	n/a	30	338	(125 m) 20%	Mabee, T. J., J. H. Plissner, B. A. Cooper, J. B. Barna. 2006. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Clinton County Windparks, New York, Spring and Fall 2005. Final Report prepared by ABR, Inc. for Ecology and Environment, Inc. and Noble Environmental Power, LLC.
Sheldon, Wyoming Cty, NY	38	272	Agricultural plateau	112	6-558	25	422	(120 m) 6%	Woodlot Alternatives, Inc. 2006. A Spring 2005 Radar Survey of Bird Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy.
Munnsville, Madison Cty, NY	41	388	Agricultural plateau	160	6-1065	31	291	(118 m) 25%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
Sheffield, Caledonia Cty, VT	20	180	Forested ridge	166	12-440	40	552	(125 m) 6%	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
Stamford, Delaware Cty, NY	35	301	Forested ridge	210	10-785	46	431	(110 m) 8%	Woodlot Alternatives, Inc. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD.
Churubusco, Clinton Cty, NY	39	310	Great Lakes plain/ADK foothills	254	3-728	40	422	(120 m) 11%	Woodlot Alternatives, Inc. 2005. A Spring Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation.
Prattsburgh, Steuben Cty, NY	20	183	Agricultural plateau	277	70-621	22	370	(125 m) 16%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC.
Deerfield, Bennington Cty, VT	20	183	Forested ridge	404	74-973	69	523	(100 m) 4%	Woodlot Alternatives, Inc. 2005. Spring 2005 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
Jordanville, Herkimer Cty, NY	40	364	Agricultural plateau	409	26-1410	40	371	(125 m) 21%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Jordanville Wind Project in Jordanville, New York. Prepared for Community Energy, Inc.
Franklin, Pendleton Cty, NY	21	204	Forested ridge	457	34-1240	53	492	(125 m) 11%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia. Prepared for US Wind Force, LLC.
Clayton, Jefferson Cty, NY	36	303	Agricultural plateau	460	71-1769	30	443	(150 m) 14%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable.
Dans Mountain, Allegany Cty, MD	23	189	Forested ridge	493	63-1388	38	541	(125 m) 15%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Dan's Mountain Wind Project in Frostburg, Maryland. Prepared for US Wind Force.
Fairfield, Herkimer Cty, NY	40	369	Agricultural plateau	509	80-1175	44	419	(145 m) 16%[1]	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar Survey of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable.
Spring 2006									
Kibby, Franklin Cty, ME (Range 1)	10	80	Forested ridge	197	6-471	50	412	(120 m) 22%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Deerfield, Bennington Cty, VT	26	236	Forested ridge	263	5-934	58	435	(100 m) 11%	Woodlot Alternatives, Inc. 2006. Spring 2006 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.

Project Site	Number of Survey Nights	Number of Survey Hours	Landscape	Average Passage Rate (t/km/hr)	Range in Nightly Passage Rates	Average Flight Direction	Average Flight Height (m)	(Turbine Ht) % Targets Below Turbine Height	Reference
Centerville, Allegany Cty, NY	42	n/a	Agricultural plateau	290	25-1140	22	351	(125 m) 16%	Mabee, T.J., J.H. Plissner, and B.A. Cooper. 2006a. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks, New York, Spring 2006. Report prepared for Ecology and Environment, LLC and Noble Environmental Power, LLC. July 2006.
Wethersfield, Wyoming Cty, NY	44	n/a	Agricultural plateau	324	41-907	12	355	(125 m) 19%	Mabee, T.J., J.H. Plissner, and B.A. Cooper. 2006a. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks, New York, Spring 2006. Report prepared for Ecology and Environment, LLC and Noble Environmental Power, LLC. July 2006.
Mars Hill, Aroostook Cty, ME	15	85	Forested ridge	338	76-674	58	384	(120 m) 14%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Radar, Visual, and Acoustic Survey of Bird Migration at the Mars Hill Wind Farm in Mars Hill, Maine. Prepared for Evergreen Windpower, LLC.
Chateaugay, Franklin Cty, NY	35	300	Agricultural plateau	360	54-892	48	409	(120 m) 18%	Woodlot Alternatives, Inc. 2006. Spring 2006 Radar Surveys at the Proposed Chateaugay Windpark in Chateaugay, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
Howard, Steuben Cty, NY	42	440	Agricultural plateau	440	35-2270	27	426	(125 m) 13%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
Kibby, Franklin Cty, ME (Valley)	2	14	Forested ridge	443	45-1242	61	334	(120 m) n/a	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Kibby, Franklin Cty, ME (Mountain)	6	33	Forested ridge	456	88-1500	67	368	(120 m) 14%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Kibby, Franklin Cty, ME (Range 2)	7	57	Forested ridge	512	18-757	86	378	(120 m) 25%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Spring 2007									
Stetson, Washington Cty, ME	21	138	Forested ridge	147	3-434	55	210	(120 m) 22%	Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC.
Cape Vincent, Jefferson Cty, NY	50	300	Great Lakes plain	166	n/a	34	441	(125 m) 14%	Western EcoSystems Technology, Inc. (WEST). 2007. Avian and Bat Studies for the Proposed Cape Vincent Wind Power Project, Jefferson County, NY. Prepared for BP Alternative Energy North America.
Arkwright, Chautauqua County, NY	41	n/a	Great Lakes plain	175	n/a	18	450	(125 m) 13%	Kerns, J., D. P. Young, C. S. Nations, V. K. Poulton. 2008. Avian and Bat Studies for the Proposed New Grange Wind Project, Chautauqua County, New York. Final Report prepared by WEST, Inc. for New Grange Wind Farm LLC.
Laurel Mountain, Barbour Cty, WV	20	197	Forested ridge	277	13-646	27	533	(130 m) 3%	Stantec Consulting Services Inc. 2007. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia. Prepared for AES Laurel Mountain, LLC.
Granite Reliable Power, Coos County, NH	30	212	Forested ridge	342	2 to 870	76	332	(125 m) 14%	Stantec Consulting Inc. 2007. Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC.
Villenova, Chautauqua Cty, NY	40	n/a	Great Lakes plain	419	22-1190	10	493	(120 m) 3%	Stantec Consulting Services Inc. 2008. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment.
Roxbury, Oxford Cty, ME	20	n/a	Forested ridge	539	137-1256	52	312	(130 m) 18%	Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Record Hill Wind Project, Roxbury, Maine. Prepared for Roxbury Hill Wind LLC.
Lempster, Sullivan Cty, NH	30	277	Forested ridge	542	49-1094	49	358	(125 m) 18%	Woodlot Alternatives, Inc. 2007.A Spring 2007 Survey of Nocturnal Bird Migration, Breeding Birds, and Bicknell's Thrush at the Proposed Lempster Mountain Wind Power Project Lempster, New Hampshire. Prepared for Lempster Wind, LLC.

Project Site	Number of Survey Nights	Number of Survey Hours	Landscape	Average Passage Rate (t/km/hr)	Range in Nightly Passage Rates	Average Flight Direction	Average Flight Height (m)	(Turbine Ht) % Targets Below Turbine Height	Reference
Spring 2008									
Allegany, Cattaraugus Cty, NY	30	275	Forested ridge	268	53-755	18	316	(150 m) 19%	Stantec Consulting Services Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report, Visual, Radar, and Acoustic Bat Surveys for the Allegany Wind Project in Allegany, New York. Prepared for Allegany Wind, LLC. October 2008
Oakfield, Penobscot Cty, ME	20	194	Forested ridge	498	132-899	33	276	(120 m) 21%	Stantec Consulting Services Inc. 2008.A Spring 2008 Survey of Bird and Bat Migration at the Oakfield Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC.
Hounsfield, Jefferson Cty, NY	42	379	Great Lakes island	624	74-1630	51	319	(125 m) 19%	Stantec Consulting Services Inc. 2008. A Spring 2008 Survey of Bird Migration at the Hounsfield Wind Project, New York. Prepared for American Consulting Professionals of New York, PLLC.
New Creek, Grant Cty, WV	20	n/a	Forested ridge	1020	289-2610	30	354	(130 m) 13%	Stantec Consulting Services Inc. 2008. A Spring 2008 Survey of Bird Migration at the New Creek Wind Project, West Virginia. Prepared for AES New Creek, LLC.
Groton Wind, Grafton Cty, NH	40	373	Forested ridge	234	35-549	77	321	(125 m) 12%	Stantec Consulting Services Inc. 2008. Spring 2008 Radar Survey Report for the Groton Wind Project. Prepared for Groton Wind, LLC.
Rollins, Penobscot Cty, ME	20	189	Forested ridge	247	40 - 766	75	316	(120 m) 13%	Stantec Consulting. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for First Wind, LLC.
Spring 2009									
Sisk (Kibby Expansion), Franklin Cty, ME	21	193	Forested ridge	207	50-452	28	293	(125 m) 18%	Stantec Consulting Services Inc. 2009. Spring 2009 Nocturnal Migration Survey Report for the Kibby Expansion Wind Project. Prepared for TRC Engineers LLC.
Moresville, Delaware Cty, NY	30	275	Forested ridge	230	30-575	53	314	(125 m)12%	Stantec Consulting Services Inc. 2009. 2009 Spring Nocturnal Radar Survey Report for the Moresville Energy Center. Prepared for Moresville Energy LLC.
Highland, Somerset Cty, ME (location 1)	21	192	Forested ridge	496	10-1262	47	287	(130.5m) 26%	Stantec Consulting Services Inc. 2009. Spring 2009 Ecological Surveys for the Highland Wind Project. Prepared for Highland Wind LLC
Highland, Somerset Cty, ME (location 2)	19	161	Forested ridge	511	8-1735	53	314	(130.5m) 23%	Stantec Consulting Services Inc. 2009. Spring 2009 Ecological Surveys for the Highland Wind Project. Prepared for Highland Wind LLC
Spring 2010									
Bowers, Carroll Plantation, ME	20	188	Forested ridge	289	20-589	56	243	(131 m) 26%	Stantec Consulting Services Inc. 2010. Draft 2010 Spring Avian and Spring/Summer Bat Surveys for the Bowers Wind Project. Prepared for Champlain Wind Energy LLC.
Bull Hill, T16 MD, ME	20	184	Forested ridge	387	43-879	48	217	(145 m) 38%	Stantec Consulting Services Inc. 2010. Spring 2010 Avian and Bat Survey Report for the Bull Hill Wind Project. Prepared for Blue Sky East Wind LLC.
Bingham, Somerset Cty, ME	20	184	Forested ridge	543	51-1231	43	355	(152 m) 21%	Stantec Consulting Services Inc. 2010. Spring 2010 Avian and Bat Survey Report for the Bingham Wind Project. Prepared for Blue Sky East Wind LLC.
Spring 2011									
Antrim, Hillsborough Cty,NH	30	284	Forested ridge	223	6-1215	44	305	(150 m) 30%	Stantec Consulting Services. 2011. Spring 2011 Radar and Acoustic Bat Survey Report for the Antrim Wind Energy Project in Antrim, New Hampshire. Prepared for Eolian Renewable Energy.
Passadumkeag, Grand Falls Township, ME	20	179	Forested ridge	476	Mar-50	67	321	(140 m) 28%	Stantec Consulting Services. 2011. Spring and Summer 2011 Avian and Bat Survey Report for the Passadumkeag Wind Project in Grand Falls Township, Maine. Prepared for Passadumkeag Windpark LLC.
Bull Hill, T16 MD, ME	10	94	Forested ridge	519	88-1108	98	371	(145 m) 21%	Stantec Consulting Services Inc. 2011. Spring 2011 Radar Survey Results and Comparison to Spring 2010 Results:Memo for the Bull Hill Wind Project. Prepared for First Wind.

[1] The percent targets below turbine height can be found in the addendum to the report "Effect of Top Notch (now Hardscrabble) Wind Project revision to turbine layout and model changes on the spring and fall 2005 nocturnal radar survey reports." Prepared August 26, 2009, by Stantec Consulting Services Inc.

Appendix B Table 12. Summary of available avian fall radar survey results conducted at proposed (pre-construction) US wind power facilities in eastern US, using X-band mobile radar systems (2004-present).

Project Site	Number of Survey Nights	Number of Survey Hours	Landscape	Average Passage Rate (t/km/hr)	Range in Nightly Passage Rates	Average Flight Direction	Average Flight Height (m)	(Turbine Ht) % Targets Below Turbine Height	Reference
Fall 2004									
Maple Ridge, Lewis Cty, NY	57	n/a	Agricultural plateau	158	n/a	181	415	(125 m) 8%	Mabee, T. J., J. H. Plissner, B. A. Cooper. 2005. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Flat Rock Wind Power Project, New York, Fall 2004. Prepared by ABR, Inc. for Atlantic Renewable Energy Coorporation
Sheffield, Caledonia Cty, VT	18	176	Forested ridge	91	19-320	200	566	(125 m) 1%	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
Dans Mountain, Allegany Cty, MD	34	318	Forested ridge	188	2-633	193	542	(125 m) 11%	Woodlot Alternatives, Inc. 2004. A Fall 2004 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Dan's Mountain Wind Project in Frostburg, Maryland. Prepared for US Wind Force.
Prattsburgh, Steuben Cty, NY	30	315	Agricultural plateau	193	12-474	188	516	(125 m) 3%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC.
Franklin, Pendleton Cty, WV	34	349	Forested ridge	229	7-926	175	583	(125 m) 8%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia. Prepared for US Wind Force, LLC.
Fall 2005									
Dairy Hills, Wyoming Cty, NY	57	n/a	Agricultural plateau	64	n/a	180	466	(125 m) 10%	Young, D. P., C. S. Nations, V. K. Poulton, J. Kerns, L. Pavalonis. 2006. Avian and Bat Studies for the Proposed Dairy Hills Wind Project, Wyoming County, New York. Final Report prepared by WEST, Inc. for Horizon Wind Energy.
Alabama, Genesee Cty, NY	59	n/a	Agricultural plateau	67	n/a	219	489	(125 m) 11%	Young, D. P., C. S. Nations, V. K. Poulton, J. Kerns. 2007. Avian and Bat Studies for the Proposed Alabama Ledge Wind Project, Genesee County, New York. Final Report prepared by WEST, Inc. for Horizon Wind Energy.
Churubusco, Clinton Cty, NY	38	414	Great Lakes plain/ADK foothills	152	9-429	193	438	(120 m) 5%	Woodlot Alternatives, Inc. 2005. A Fall Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation.
Sheldon, Wyoming Cty, NY	36	347	Agricultural plateau	197	43-529	213	422	(120 m) 3%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar Survey of Bird Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy.
Noble C/E/A, Clinton Cty, NY	57	n/a	Great Lakes plain/ADK foothills	197	n/a	162	333	(125 m) 12%	Mabee, T. J., J. H. Plissner, B. A. Cooper, J. B. Barna. 2006. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Clinton County Windparks, New York, Spring and Fall 2005. Final Report prepared by ABR, Inc. for Ecology and Environment, Inc. and Noble Environmental Power, LLC.
Prattsburgh, Steuben Cty (Ecogen), NY	45	n/a	Agricultural plateau	200	n/a	177	365	(125 m) 9%	Mabee, T. J., Plissner, J. H., Cooper, B. A. 2004. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Prattsbugh-Italy Wind Power Project, New York, Fall 2004. Final Report prepared by ABR, Inc. for Ecogen, LLC.
Kibby, Franklin Cty, ME (Range 1)	12	101	Forested ridge	201	12-783	196	352	(125 m) 12%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Stamford, Delaware Cty, NY	48	418	Forested ridge	315	22-784	251	494	(110 m) 3%	Woodlot Alternatives, Inc. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD.
Preston Cty, WV	26	n/a	Forested ridge	379	n/a	n/a	420	(125 m) 10%	Plissner, J.H., T.J. Mabee, and B.A. Cooper. 2006 A radar and visual study of nocturnal bird and bat migration at the proposed Preston Wind

Project Site	Number of Survey Nights	Number of Survey Hours	Landscape	Average Passage Rate (t/km/hr)	Range in Nightly Passage Rates	Average Flight Direction	Average Flight Height (m)	(Turbine Ht) % Targets Below Turbine Height	Reference
									Development project, Virginia, Fall 2005. Report to Highland New Wind Development, LLC.
Jordanville, Herkimer Cty, NY	38	404	Agricultural plateau	380	26-1019	208	440	(125 m) 6%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Jordanville Wind Project in Stark and Warren, NY. Fall 2005 Final Report prepared for Community Energy, Inc.
Highland, VA	58	n/a	Forested ridge	385	n/a	n/a	442	(125 m) 12%	Plissner, J.H., T.J. Mabee, and B.A. Cooper. 2006 A radar and visual study of nocturnal bird and bat migration at the proposed Highland New Wind Development project, Virginia, Fall 2005. Report to Highland New Wind Development, LLC.
Clayton, Jefferson Cty, NY	37	385	Agricultural plateau	418	83-877	168	475	(150 m) 10%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable.
Bliss, Wyoming Cty, NY	8	n/a	Agricultural plateau	444	n/a	n/a	411	(125 m) 13%	Ecology and Environment, Inc. 2006. Avian and Bat Risk Assessment Bliss Windpark Town of Eagle, Wyoming County, New York. Prepared for Noble Environmental Power, LLC.
Kibby, Franklin Cty, ME (Valley)	5	13	Forested ridge	452	52-995	193	391	(125 m) 16%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Mars Hill, Aroostook Cty, ME	18	117	Forested ridge	512	60-1092	228	424	(120 m) 8%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird Migration at the Mars Hill Wind Farm in Mars Hill, Maine. Prepared for Evergreen Windpower, LLC.
Howard, Steuben Cty, NY	39	405	Agricultural plateau	481	18-1434	185	491	(125 m) 5%	Woodlot Alternatives, Inc. 20065 A Fall 2005 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
Deerfield, Bennington Cty, VT	32	324	Forested ridge	559	3-1736	221	395	(100 m) 13%	Woodlot Alternatives, Inc. 2006. Fall 2005 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
Kibby, Franklin Cty, ME (Mountain)	12	115	Forested ridge	565	109-1107	167	370	(125 m) 16%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
Fairfield, Herkimer Cty, NY	38	423	Agricultural plateau	691	116-1351	198	516	(145 m) 6%[1]	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar Survey of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable.
Munnsville, Madison Cty, NY	31	292	Agricultural plateau	732	15-1671	223	644	(118 m) 2%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
Fall 2006									
Villenova, Chautauqua Cty, NY	36	n/a	Great Lakes plain	189	16-604	216	353	(120 m) 9%	Stantec Consulting Services Inc. 2008. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment.
Wethersfield, Wyoming Cty, NY	56	n/a	Agricultural plateau	256	31-701	203	344	(125 m) 11%	Mabee, T. J., J. H. Plissner, J. B. Barna, B. A. Cooper. 2006. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Centerville and Wethersfield windparks, New York, Fall 2006. Final Report prepared by ABR, Inc. for Ecology and Environment and Noble Environmental Power, LLC
Centerville, Allegany Cty, NY	57	n/a	Agricultural plateau	259	12-877	208	305	(125 m) 12%	Mabee, T. J., J. H. Plissner, J. B. Barna, B. A. Cooper. 2006. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Centerville and Wethersfield windparks, New York, Fall 2006. Final Report prepared by ABR, Inc. for Ecology and Environment and Noble Environmental Power, LLC

Project Site	Number of Survey Nights	Number of Survey Hours	Landscape	Average Passage Rate (t/km/hr)	Range in Nightly Passage Rates	Average Flight Direction	Average Flight Height (m)	(Turbine Ht) % Targets Below Turbine Height	Reference
Cape Vincent, Jefferson Cty, NY	60	n/a	Great Lakes plain	346	n/a	209	490	(125 m) 8%	Young, D. P., J. J. Kerns, C. S. Nations, V. K. Poulton. 2007. Avian and Bat Studies for the Proposed Cape Vincent Wind Project Jefferson County, New York. Final Report prepared by WEST, Inc. for BP Alternative Energy.
Stetson, Washington Cty, ME	12	77	Forested ridge	476	131-1192	227	378	(125 m) 13%	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC.
Dutch Hill, Steuben Cty, NY	21	n/a	Agricultural plateau	535	n/a	215	358	(125 m) 11%	Woodlot Alternatives, Inc. 2006. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Dutch Hill Wind Project Cohocton, New York. Prepared for UPC Wind Management, LLC.
Lempster, Sullivan Cty, NH	32	290	Forested ridge	620	133-1609	206	387	(125 m) 8%	Woodlot Alternatives, Inc. 2007. A Fall 2007 Survey of Nocturnal Bird Migration, Breeding Birds, and Bicknell's Thrush at the Proposed Lempster Mountain Wind Power Project Lempster, New Hampshire. Prepared for Lempster Wind, LLC.
Chateaugay, Franklin Cty, NY	35	327	Agricultural plateau	643	38-1373	212	431	(120 m) 8%	Woodlot Alternatives, Inc. 2006. Fall 2006 Radar Surveys at the Proposed Chateaugay Windpark in Chateaugay, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
Granite Reliable Power, Coos Cty, NH	30	328	Forested ridge	469	22-1098	223	455	(125 m) 1%	Stantec Consulting Inc. 2007. Fall 2006 Radar Surveys of Nighttime Migration Activity at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC.
Fall 2007									
Arkwright, Chautauqua Cty, NY	57	n/a	Great Lakes plain	112	n/a	208	458	(125 m) 10%	Kerns, J., D. P. Young, C. S. Nations, V. K. Poulton. 2008. Avian and Bat Studies for the Proposed New Grange Wind Project, Chautauqua County, New York. Final Report prepared by WEST, Inc. for New Grange Wind Farm LLC.
Laurel Mountain, Barbour Cty, WV	20	212	Forested ridge	321	76-513	209	533	(130 m) 6%	Stantec Consulting Services Inc. 2007. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia. Prepared for AES Laurel Mountain, LLC.
Granite Reliable Power, Coos County, NH	29	232	Forested ridge	366	54 to 1234	223	343	(125 m) 15%	Stantec Consulting Inc. 2007. Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC.
Rollins, Lincoln, Penobscot Cty, ME	22	231	Forested ridge	368	82-953	284	343	(120 m) 13%	Woodlot Alternatives, Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the Rollins Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC.
Roxbury, Oxford Cty, ME	20	220	Forested ridge	420	88-1006	227	365	(130 m) 14%	Woodlot Alternatives, Inc. 2007. A Fall 2007 Survey of Bird and Bat Migration at the Record Hill Wind Project, Roxbury, Maine. Prepared for Roxbury Hill Wind LLC.
Allegany, Cattaraugus Cty, NY	46	n/a	Forested ridge	451	n/a	230	382	(150 m) 10%	Stantec Consulting. 2008. Fall Bird and Bat Migration Survey Report, Visual, Radar, and Acoustic Bat Surveys for the Allegany Wind Project in Allegany, New York. Prepared for Allegany Wind, LLC. March 2008 (updated January 2010).
New Creek, Grant Cty, WV	20	n/a	Forested ridge	811	263-1683	231	360	(130 m) 17%	Stantec Consulting Services Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the New Creek Wind Project, West Virginia. Prepared for AES New Creek, LLC.
Fall 2008									
Hounsfield, Jefferson Cty, NY	60	674	Great Lakes island	281	64-835	207	298	(125 m) 17%	Stantec Consulting Services Inc. 2008. A Fall 2008 Survey of Bird Migration at the Hounsfield Wind Project, New York. Prepared for American Consulting Professionals of New York, PLLC.

Project Site	Number of Survey Nights	Number of Survey Hours	Landscape	Average Passage Rate (t/km/hr)	Range in Nightly Passage Rates	Average Flight Direction	Average Flight Height (m)	(Turbine Ht) % Targets Below Turbine Height	Reference
Georgia Mountain, VT	21	n/a	Forested ridge	326	56-700	230	371	(120 m) 7%	Stantec Consulting Services Inc. 2008. A Fall 2008 Survey of Bird Migration at the Georgia Mountain Wind Project, Vermont. Prepared for Georgia Mountain Community Wind.
Oakfield, Penobscot Cty, ME	20	n/a	Forested ridge	501	116-945	200	309	(125 m) 18%	Woodlot Alternatives, Inc. 2008. A Fall 2008 Survey of Bird and Bat Migration at the Oakfield Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC.
Groton Wind, Grafton Cty, NH	45	509	Forested ridge	470	94-1174	260	342	(125m) 13%	Stantec Consulting Services Inc. 2008. Fall 2008 Radar Survey Report for the Groton Wind Project. Prepared for Groton Wind, LLC.
Highland, Somerset Cty, ME	20	216	Forested ridge	549	68-1201	227	348	(130.5m) 17%	Stantec Consulting. 2009. Fall 2008 Bird and Bat Migration Survey Report: Radar and Acoustic Avian and Bat Surveys for the Highland Wind Project Highland Plantation, Maine. Prepared for Highland Wind LLC
Fall 2009									
Sisk (Kibby Expansion) Franklin Cty, ME	20	210	Forested ridge	458	44-1067	206	287	(125m) 23%	Stantec Consulting Services. 2009. Fall 2009 Nocturnal Migration Survey Report. Prepared for TRC Engineers LLC.
Stetson, Washington Cty, ME	18	201	Forested ridge	457	106-1746	227	420	(119m) 2%	Stantec Consulting Services. 2010. Stetson I Mountain Wind Project Year 1 Post-Construction Monitoring Report, 2009. Prepared for First Wind Management, LLC.
Bull Hill, Hancock Cty, ME	20	232	Forested ridge	614	188-1500	260	357	(145m) 20%	Stantec Consulting Services. 2010. Summer and Fall 2009 Avian and Bat Survey Report for the Bull Hill Project. Prepared for Blue Sky East Wind, LLC.
Bowers, Washington Cty, ME	22	249	Forested ridge	344	95-844	231	453	(119m) 14%	Stantec Consulting Services Inc. 2010. 2010 Spring Avian and Spring/Summer Bat Surveys for the Bowers Wind Project. Prepared for Champlain Wind Energy, LLC.
Fall 2010									
Bingham, Somerset Cty, ME	20	232	Forested ridge	803	194-2463	234	378	(152m) 20%	Stantec Consulting Services Inc. 2010. 2010 Spring Avian and Spring/Summer Bat Surveys for the Bowers Wind Project. Prepared for Champlain Wind Energy, LLC.
Fall 2011									
Antrim, Hillsborough Cty,NH	30	327	Forested ridge	138	4-538	217	203	(150m) 40%	Stantec Consulting Services. 2011. Summer and Fall 2011 Radar and Acoustic Bat Survey Report for the Antrim Wind Energy Project in Antrim, New Hampshire. Prepared for Antrim Wind Energy, LLC.
Passadumkeag, Grand Falls Township, ME	20	222	Forested ridge	394	65-1281	251	325	(140m) 22%	Stantec Consulting Services. 2011. Summer and Fall 2011 Avian and Bat Survey Report for the Passadumkeag Wind Project in Grand Falls Township, Maine. Prepared for Passadumkeag Windpark LLC.
Bull Hill, T16 MD, ME	10	112	Forested ridge	431	111-747	282	279	(145m) 26%	Stantec Consulting Services Inc. 2011. Fall 2011 Radar Survey Results and Comparison to Fall 2009 Radar Results:Memo for the Bull Hill Wind Project. Prepared for Blue Sky East Wind, LLC.

[1] The percent targets below turbine height can be found in the addendum to the report "Effect of Top Notch (now Hardscrabble) Wind Project revision to turbine layout and model changes on the spring and fall 2005 nocturnal radar survey reports." Prepared August 26, 2009, by Stantec Consulting Services Inc.

Appendix B Table 13. Available pre-construction fall radar survey results and post-construction estimated bird mortality at wind sites in the East.

Project Site	Number of Survey Nights	Average Passage Rate (t/km/hr)	Average Flight Direction	Average Flight Height (m)	(Turbine Ht) % Targets Below Turbine Height	Estimated Bird Mortality/Turbine/Study Period*	Fatality Reference (see Table 1 for radar survey reference**)
Maine							
Kibby, Franklin Cty, ME	12	565	167	370	(125 m) 16%	2011 (fall only): 0.29	Stantec Consulting. 2011. 2011 Post-Construction Monitoring Report Kibby Wind Power Project, Franklin County, Maine. Prepared for TransCanada Hydro Northeast, Inc.
Mars Hill, Aroostook Cty, ME	18	512	228	424	(120 m) 8%	2008: 0.44 - 2.5; 2009: 2.4 - 2.65	Stantec Consulting. 2008. Spring, Summer, and Fall Post-construction Bird and Bat Mortality Study at the Mars Hill Wind Farm, Maine. Unpublished report prepared for UPC Wind Management, LLC. Stantec Consulting. 2009. Post-construction Monitoring at the Mars Hill Wind Farm, Maine – Year 2. Unpublished report prepared for First Wind Management, LLC.
Record Hill, Oxford Cty, ME	20	420	227	365	(130 m) 14%	2012: 8.46	Stantec Consulting. 2012. Record Hill Wind Project Post-Construction Monitoring Report, 2012. Prepared for Record Hill Wind, LLC.
Rollins, Penobscot Cty, ME	22	368	284	343	(120 m) 13%	2012: 2.94	Stantec Consulting. 2012. RollinsWind Project Post-Construction Monitoring Report, 2012. Prepared for First Wind, LLC.
Stetson I, Washington Cty, ME	12	476	227	378	(125 m) 13%	2009 Stetson I: 4.03	Stantec Consulting Services. 2010. Stetson I Mountain Wind Project Year 1 Post-Construction Monitoring Report, 2009. Prepared for First Wind Management, LLC.
Stetson II, Washington Cty, ME	18	457	227	420	(119 m) 2%	2010 Stetson II: 2.14	Normandeau Associates. 2010. Stetson Mountain II Wind Project Year 1 Post-Construction Avian and Bat Mortality Monitoring. Prepared for First Wind, LLC.
New Hampshire							
Granite Reliable, Coos County, NH	29	366	223	343	(125 m) 15%	2.0-2.8	Curry and Kerlinger. 2013. Post-construction mortality study Granite Reliable Power Wind Park, Coos County, New Hampshire, Annual Report January 2013. Prepared for Granite Reliable Power, LLC.
Groton, Grafton Cty, NH	45	470	260	342	(125 m) 13%	(placeholder)	West 2013
Lempster, Sullivan Cty, NH	32	620	206	387	(125 m) 8%	2010: (fall only) 5.95; 2011: (fall only) 4.12	Tidhar, D., W. Tidhar, and M. Sonnenberg. 2010. Post-Construction Fatality Surveys for Lempster Wind Project. Prepared for Lempster Wind, LLC. Tidhar, D., W. Tidhar, L. McManus, and Z. Courage. 2011. 2010 Post-Construction Fatality Surveys for Lempster Wind Project. Prepared for Lempster Wind, LLC.
New York							
Altona, Clinton Cty, NY	57	197	162	333	(125 m) 12%	2010: 1.55 - 2.76	Jain, A., P. Kerlinger, L. Slobodnik, R. Curry, and K. Russell. 2011. Postconstruction bird and bat fatality study - 2010. Annual report for the Noble Altona Winpark, LLC.
Bliss, Allegany Cty, NY	8	444	"southwest"	411	(125 m) 13%	2010: 2.87-4.45	Jain, A., P. Kerlinger, L. Slobodnik, R. Curry, A. Fuerst, and A. Harte. 2010. Postconstruction bird and bat fatality study - 2009. Annual report for the Noble Bliss Winpark, LLC.
Chateaugay, Franklin Cty, NY	35	643	212	431	(120 m) 8%	2010 : 2.40	Jain, A., P. Kerlinger, L. Slobodnik, R. Curry, and K. Russell. 2011. Postconstruction bird and bat fatality study - 2010. Annual report for the Noble Chateaugay Winpark, LLC.
Clinton, Clinton Cty, NY	57	197	162	333	(125 m) 12%	2009: 1.5 - 1.76	Jain, A., P. Kerlinger, L. Slobodnik, R. Curry, and K. Russell. 2010. Postconstruction bird and bat fatality study - 2009. Annual report for the Noble Clinton Winpark, LLC.
Dutch Hill, Steuben Cty, NY	21	535	215	358	(125 m) 11%	2009: 2.9 - 4.7	Stantec Consulting. 2010. Cohocton and Dutch Hill Wind FarmsYear 1 Post-Construction Monitoring Report, 2009 for the Cohocton and Dutch Hill Wind Farms In Cohocton, New York. Prepared for Canandaigua Power Partners, LLC and Canandaigua Power Partners II, LLC.

Project Site	Number of Survey Nights	Average Passage Rate (t/km/hr)	Average Flight Direction	Average Flight Height (m)	(Turbine Ht) % Targets Below Turbine Height	Estimated Bird Mortality/Turbine/Study Period*	Fatality Reference (see Table 1 for radar survey reference**)
Ellenburg, Clinton Cty, NY	57	197	162	333	(125 m) 12%	2009: 2.29 - 5.69	Jain, A., P. Kerlinger, L. Slobodnik, R. Curry, and K. Russell. 2010. Postconstruction bird and bat fatality study - 2009. Annual report for the Noble Ellenburg Winpark, LLC.
Maple Ridge, Lewis Cty, NY	57	158	181	415	(125 m) 7.6%	2006: 3.10 - 9.48; 2007: 5.67 - 6.31; 2008: 3.42 - 3.76	Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2007. Annual report for the Maple Ridge wind power project post-construction bird and bat fatality study—2006. Annual report prepared for PPM Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA. Jain, A. P. Kerlinger, R. Curry, and L. Slobodnik. 2008. Annual report for the Maple Ridge wind power project post-construction bird and bat fatality study—2007. Annual report prepared for PPM Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA. Jain, A. P. Kerlinger, R. Curry, and L. Slobodnik. 2009. Annual report for the Maple Ridge wind power project post-construction bird and bat fatality study—2008. Annual report prepared for PPM Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA.
Wethersfield, Wyoming Cty, NY	56	256	203	344	(125 m) 11%	2010 : 2.55	Jain, A., P. Kerlinger, L. Slobodnik, R. Curry, and A. Harte. 2011. Postconstruction bird and bat fatality study - 2010. Annual report for the Noble Wethersfield Winpark, LLC.
Pennsylvania							
Casselman, Somerset Cty, PA	30	174	n/a	436	(125 m) 7%	2009: 2.27	Arnett, E. B., M. R. Schirmacher, M. M. P. Huso, and J. P. Hayes. 2009. Patterns of bat fatality at the Casselman Wind Project in south-central Pennsylvania. An annual report submitted to the Bats and Wind Energy Cooperative and the Pennsylvania Game Commission. Bat Conservation International. Austin, Texas.
Vermont							
Sheffield, Caledonia Cty, VT	18	91	200	566	(125 m) 1%	2012: 13.17	Martin, C., E. Arnett, M. Wallace. 2013. Evaluating Bird and Bat Post-Construction Impacts at the Sheffield Wind Facility, Vermont 2012 Annual Report. Prepared for Bat Conservation International and First Wind.

* While all estimates listed here have been adjusted for searcher efficiency and scavenger removal rates, note that field and statistical analysis methods vary among projects.

Appendix B Table 14. Summary of publically available spring raptor survey data at proposed wind sites in the Northeast (1999-present).

Project Site	Landscape	Survey Period	# of Survey Days	# of Survey Hours	Total # Observed	# of Species Observed	Seasonal Average Passage Rate (raptors/hr)	(Turbine Ht) and % Raptors Below Turbine Height	Reference
Spring 1999									
Wethersfield, Wyoming Cty, NY	Agricultural plateau	April 20 - May 24	24	97	348	12	3.6	n/a (23 m mean flight height)	Cooper, B.A., and T.J. Mabee. 1999. Bird migration near proposed wind turbine sites at Wethersfield and Harrisburg, New York. Unpublished report prepared for Niagara–Mohawk Power Corporation, Syracuse, NY, by ABR, Inc., Forest Grove, OR. 46 pp.
Spring 2003									
Westfield, Chautauqua Cty, NY	Great Lakes Shore	April 16 - May 15	50	100.7	2,578	17	25.6	n/a (278 m mean flight height)	Cooper, B.A., A.A. Stickney, J.J. Mabee. 2004. A visual and radar study of 2003 spring bird migration at the proposed Chautauqua wind energy facility, New York. 2004. Final Report prepared by ABR Inc. Chautauqua Windpower LLC.
Spring 2005									
Churubusco, Clinton Cty, NY	Great Lakes plain/ADK foothills	Spring 2005	10	60	170	11	2.83	(120 m) 69%[1]	Woodlot Alternatives, Inc. 2005. A Spring Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation.
Clinton/Ellenburg, Clinton Cty, NY	Great Lakes plain/ADK foothills	April 18 to April 20	3	21	(2 non-migrant BWHA)	1	0.1 [2]	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Dairy Hills, Clinton Cty, NY	Great Lakes Shore	April 15 to April 26	5	20	50	6	2.5	(125 m) 94.7[1,3]	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Altona, Clinton Cty, NY	Great Lakes plain/ADK foothills	May 5 to May 6	3	21	(4 non-migrant TUVU)	1	0.19 [2]	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Bliss Wind Park, Eagle, Wyoming Cty, NY	Agricultural and wooded plateau	April 21, 26, 28	3	21	19	3	0.9	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Alabama, Genesee Cty, NY	Great Lakes plain/ADK foothills	April 16-April 29	5	20	177	8	9	(125 m) 84.5%[1,3]	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
High Sheldon, Wyoming Cty, NY	Agricultural and wooded plateau	April 2 to May 14	7	37	119	7	3.2	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Wethersfield, Wyoming Cty, NY	Agricultural and wooded plateau	April 22 to April 29	3	21	5	3	0.1	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
New Grange, Chautauqua Cty, NY	Great Lakes plain/ADK foothills	April 16 to May	5	20	55	8	4.37	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.

Project Site	Landscape	Survey Period	# of Survey Days	# of Survey Hours	Total # Observed	# of Species Observed	Seasonal Average Passage Rate (raptors/hr)	(Turbine Ht) and % Raptors Below Turbine Height	Reference
Stockton, Chautauqua Cty, NY	Great Lakes plain/ADK foothills	April 16 to May 15	5	20	122	8	4.65	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Clayton, Jefferson Cty, NY	Agricultural plateau	March 30 - May 7	10	58	700	14	12.1	(150 m) 61%[1]	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable.
Prattsburgh, Steuben Cty, NY	Agricultural plateau	Spring 2005	10	60	314	15	5.23	(125 m) 83%[1]	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC.
Cohocton, Steuben Cty, NY	Agricultural plateau	Spring 2005	10	60	164	11	2.73	(125 m) 77%[1]	Woodlot Alternatives, Inc. 2005. Avian and Bat Information Summary and Risk Assessment for the Proposed Cohocton Wind Power Project in Cohocton, New York. Prepared for UPC Wind Management, LLC.
Munnsville, Madison Cty, NY	Agricultural plateau	April 5 to May 16	10	60	375	12	6.25	(118 m) 78%[1]	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
Moresville, Delaware County, NY	Forested ridge	March 28 to May 10	8	45	170	6	3.8	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Sheffield, Caledonia Cty, VT	Forested ridge	April to May	10	60	98	10	1.63	(125 m) 69%[1]	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
Deerfield, Bennington Cty, VT (Existing facility)	Forested ridge	April 9 to April 29	7	42	44	11 (for both sites combined)	1.05	(125 m) 83% (at both sites combined)[1]	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy/Deerfield Wind, LLC.
Deerfield, Bennington Cty, VT (Western expansion)	Forested ridge	April 9 to April 29	7	42	38	11 (for both sites combined)	0.9	(125 m) 83% (at both sites combined)[1]	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy/Deerfield Wind, LLC.
Spring 2006									
Mars Hill, Aroostook Cty, ME	Forested ridge	April 12 to May 18	10	60.25	64	9	1.06	(120 m) 48%[1]	Woodlot Alternatives, Inc. 2006. A Spring 2006 Radar, Visual, and Acoustic Survey of Bird Migration at the Mars Hill Wind Farm in Mars Hill, Maine. Prepared for Evergreen Windpower, LLC.
Lempster, Sullivan County, NH	Forested ridge	Spring 2006	10	78	102	n/a	1.3	(165 m) 56%[1]	The Louis Berger Group. 2006. Pre and Post-construction Avian Survey, Monitoring, and Mitigation at the Lempster, New Hampshire Wind Power Project. Prepared for Lempster Wind, LLC.
Howard, Steuben Cty, NY	Agricultural plateau	April 3 to May 19	9	52.5	260	11	4.95	(125 m) 64%[1]	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for EverPower Global.
Chateaugay, Franklin Cty, NY	Great Lakes plain/ADK foothills	April 19 to April 28	3	21	47	12	1.9	(121 m) 3%[1]	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.

Project Site	Landscape	Survey Period	# of Survey Days	# of Survey Hours	Total # Observed	# of Species Observed	Seasonal Average Passage Rate (raptors/hr)	(Turbine Ht) and % Raptors Below Turbine Height	Reference
St. Lawrence, Jefferson Cty, NY	Great Lakes Shore	April 14 to May 12	4	12	91	8	7.5	(125 m) 81%[1,4]	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Cape Vincent, Jefferson Cty, NY	Great Lakes Shore	April 14 to May 12	4	12	79	10	6.5	(125 m) 72%[1]	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Stockton, Chautauqua Cty, NY	Great Lakes plain/ADK foothills	n/a	n/a	n/a	n/a	n/a	4.65	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Spring 2007									
St Lawrence, Jefferson Cty, NY	Great Lakes Shore	March 21 to May 1	7	21	232	8	15.4	(125 m) 81%[1,4]	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Cape Vincent, Jefferson Cty, NY	Great Lakes Shore	March 21 to May 1	7	21	205	9	9.8	(125 m) 72%[1]	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
New Grange, Chautauqua Cty, NY	Great Lakes plain/ADK foothills	April 26 to May 22	5	n/a	n/a	n/a	4.37	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Jericho Rise, Franklin Cty, NY	Great Lakes plain/ADK foothills	April 4 to May 28	8	32	112	10	3	(125 m) 74.6%[1]	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Stetson, Penobscot Cty, ME	Forested ridge	April 26 to May 4	9	59	34	10	0.6	(125 m) 65%[1]	Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC.
Laurel Mountain, Preston Cty, WV	Forested ridge	March 30 to May 17	10	63.75	266	12	4.17	(125 m) 55%[5]	Stantec Consulting. 2008. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia – November 2007. Prepared for AES Laurel Mountain, LLC.
Spring 2008									
Oakfield, Aroostook Cty, ME	Forested ridge	April 25-May 30	12	79	58	9	0.7	(120 m) 80%[5]	Stantec Consulting. 2008. Spring and Summer 2008 Bird and Bat Migration Survey Report Visual, Radar, and Acoustic Bat Surveys for the Oakfield Wind Project in Oakfield, Maine. Prepared for First Wind Management, LLC.
Record Hill, Oxford Cty, ME	Forested ridge	March 11 to May 27	15	97	118	12	1.2	n/a	Stantec Consulting. 2008. Spring 2008 Bird and Bat Migration Survey Report Breeding Bird, Raptor, and Acoustic Bat Surveys for the Record Hill Wind Project Roxbury, Maine. Prepared for Record Hill Wind, LLC.
Greenland, Grant Cty, WV	Forested ridge	March 21 to May 14	10	68	212	9	3.12	(125 m) 68%[5]	Stantec Consulting. 2008. Spring, Summer, and Fall 2008 Bird and Bat Migration Survey Report Visual, Radar, and Acoustic Bat Surveys for the New Creek Mountain Project West Virginia. Prepared for AES New Creek, LLC.

Project Site	Landscape	Survey Period	# of Survey Days	# of Survey Hours	Total # Observed	# of Species Observed	Seasonal Average Passage Rate (raptors/hr)	(Turbine Ht) and % Raptors Below Turbine Height	Reference
Buckeye, Champaign Cty, OH	Agricultural plateau	March 1 to May 15	32	216	1476	12	6.8	(150 m) 95%[1]	Stantec Consulting. 2009. Spring, Summer and Fall 2008 Bird and Bat Survey Report. Prepared for EverPower Wind Holdings, Inc.
Allegany, Cattaraugus Cty, NY	Forested ridge	March 23 to May 8	10	75	134	10	1.8	(150 m) 87%[5]	Stantec Consulting. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar, and Acoustic Bat Surveys for the Allegany Wind Project. Prepared for EverPower Renewables
Rollins Mountain, Penobscot Cty, ME	Forested ridge	Apr 3 to Jun 3	15	108	122	12	1.1	(125 m) 76%[5]	Stantec Consulting. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for First Wind, LLC.
Spring 2009									
Stetson, Penobscot Cty, ME	Forested ridge	April 27 to May 5	4	20	34	11	1.7	(119 m) 67%[3,5]	Stantec Consulting. 2009. Stetson I Mountain Wind Project Year 1 Post-Construction Monitoring Report, 2009. Prepared for First Wind Management, LLC
Groton Wind, Grafton Cty, NH	Forested ridge	March 26 to May 23	11 [6]	125 [6]	175 [6]	11	1.4 [6]	(121 m) 25%[5]	Stantec Consulting Services Inc. 2009. 2009 Spring, Summer, and Fall Avian and Bat Surveys for the Groton Wind Project. Prepared for Groton Wind, LLC.
Highland, Somerset Cty, ME	Forested ridge	March 25 to May 19	20	139	260	10	1.87	(130.5 m) Whitham 80% Briggs 86%[5]	Stantec Consulting Services Inc. 2009. Spring 2009 Ecological Surveys. Prepared for Highland Wind LLC.
Kingdom Community, Orleans Cty, VT	Forested ridge	April 15 to June 1	10	74	134	10	1.81	(125 m) 67%[1]	Stantec Consulting. 2009. Spring and Summer 2009 Raptor Surveys for the Kingdom Community Wind Project. Prepared for Vermont Environmental Research Associates
Spring 2010									
Granite Reliable Power, Coos County, NH (Dixville peak)	Forested ridge	April 1 to May 11	10	67.52	14	8	0.21	(125 m) 64%[1]	Stantec Consulting. 2010. Fall 2009 and Spring 2010 Raptor Migration Surveys For the Granite Reliable Power Project. Prepared for Granite Reliable Power, LLC
Granite Reliable Power, Coos County, NH (Owl head mtn)	Forested ridge	April 1 to May 11	10	62.45	29	8	0.46	(125 m) 76%[1]	Stantec Consulting. 2010. Fall 2009 and Spring 2010 Raptor Migration Surveys For the Granite Reliable Power Project. Prepared for Granite Reliable Power, LLC
Bull Hill, Hancock Cty, ME	Forested ridge	March 19 to May 23	15	104.25	55	9	0.53	(145 m) 100%[5]	Stantec Consulting. 2010. Spring 2010 Avian and Bat Survey Report for the Bull Hill Wind Project. Prepared for Blue Sky East Wind, LLC
Bingham, Somerset Cty, ME (Kingsbury Ridge)	Forested ridge	March 19 to May 21	10	70	19	9	0.27	(152 m) 77%[5]	Stantec Consulting Services Inc. 2010. Spring 2010 Avian and Bat Survey Report for the Bingham Wind Project. Prepared for Blue Sky East Wind LLC.
Bingham, Somerset Cty, ME (Johnson Ridge)	Forested ridge	March 19 to May 21	5	35	37	9	1.06	(152 m) 95%[5]	Stantec Consulting Services Inc. 2010. Spring 2010 Avian and Bat Survey Report for the Bingham Wind Project. Prepared for Blue Sky East Wind LLC.
Bowers, Washington Cty, ME	Forested ridge	April 21 to May 26	12	84	131	9	1.56	(131 m) 75%[5]	Stantec Consulting. 2010. 2010 Spring Avian and Spring/Summer Bat Surveys for the Bowers Wind Project. Prepared for Champlain Wind Energy, LLC

Project Site	Landscape	Survey Period	# of Survey Days	# of Survey Hours	Total # Observed	# of Species Observed	Seasonal Average Passage Rate (raptors/hr)	(Turbine Ht) and % Raptors Below Turbine Height	Reference
Spring 2011									
Antrim, Hillsborough Cty, NH	Forested ridge	March 25 to May 15	9	65	441	11	6.78	(unknown) 37% between 50-500 ft above ground[1]	TRC Engineers and Stantec Consulting Services Inc. 2011. Avian and Bat Protection Plan for the Antrim Wind Energy Project. Prepared for Antrim Wind Energy, LLC.
Passadumkeag, Grand Falls Twp, ME	Forested ridge	Apr 29 to May 27	12	84	67	6	0.8	(140 m) 46%[1]	Stantec Consulting Services Inc. 2011. Spring and Summer 2011 Avian and Bat Survey Report for the Passadumkeag Wind Project in Grand Falls Township, Maine. Prepared for Noble Passadumkeag Windpark LLC.

[1] Percent below turbine height calculated for all observations within study area.

[2] Non-migrants were not included in seasonal passage rates in NYSDEC 2008 table but were included in passage rates here.

[3] Calculated for spring and fall combined.

[4] Calculated for spring and fall 2006 and 2007 combined.

[5] Percent below turbine height calculated for those observations within project area (locations within study area where turbines could possibly be located).

[6] 5 of the 11 survey days were conducted simultaneously by 2 observers at 2 survey locations; however, results are combined for both sites which inflates the number of raptors observed for this site.

Appendix B Table 15. Summary of available fall raptor survey results at wind sites in the Northeast (1996-present).

Project Site	Landscape	Survey Period	# of Survey Days	# of Survey Hours	Total # Observed	# of Species Observed	Seasonal Average Passage Rate (raptors/hr)	(Turbine Ht) and % Raptors Below Turbine Height	Reference
Fall 1996									
Searsburg, Bennington County, VT	Forested ridge	Sept. 11 - Nov. 3	20	80	430	12	5.4	n/a	Kerlinger, Paul. 1996. A Study of Hawk Migration at Green Mountain Power Corporation's Searsburg, Vermont, Wind Powered Site: Autumn 1996. Prepared for the Vermont Public Service Board, Green Mountain Power, National Renewable Ener gy Laboratory, VERA.
Fall 1998									
Harrisburg, Lewis County, NY	Great Lakes plain/ADK foothills	Sept. 2 - Oct. 1	13	68	554	12	8.1	n/a (48 m mean flight height)	Cooper, B.A., and T.J. Mabee. 1999. Bird migration near proposed wind turbine sites at Wethersfield and Harrisburg, New York. Unpublished report prepared for Niagara–Mohawk Power Corporation, Syracuse, NY, by ABR, Inc., Forest Grove, OR. 46 pp.
Wethersfield, Wyoming Cty, NY	Agricultural plateau	Sept. 2 - Oct. 1	24	107	256	12	2.4	n/a (47 m mean flight height)	Cooper, B.A., and T.J. Mabee. 1999. Bird migration near proposed wind turbine sites at Wethersfield and Harrisburg, New York. Unpublished report prepared for Niagara–Mohawk Power Corporation, Syracuse, NY, by ABR, Inc., Forest Grove, OR. 46 pp.
Fall 2004									
Prattsburgh, Steuben Cty, NY	Agricultural plateau	Sept. 2 - Oct. 28	13	73	220	10	3.0	(125 m) 62%[1]	Woodlot Alternatives, Inc. 2005. A Fall 2004 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC.
Cohocton, Stueben, Cty, NY	Agricultural plateau	Sept. 2 - Oct. 28	8	41.3	128	8	3.1	(125 m) 80%[1]	Woodlot Alternatives, Inc. 2005. Avian and Bat Information Summary and Risk Assessment for the Proposed Cohocton Wind Power Project in Cohocton, New York. Prepared for UPC Wind Management, LLC.
Deerfield, Bennington Cty, VT (Existing Facility)	Forested ridge	Sept. 2 - Oct. 31	10	60	147	n/a	2.5	n/a	Woodlot Alternatives, Inc. 2005. Fall 2004 Avian Migration Surveys at the Proposed Deerfield Wind/Searsburg Expansion Project in Searsburg and Readsboro, Vermont. Prepared for Deerfield Wind, LLC and Vermont Environmental Research Associates.
Deerfield, Bennington Cty, VT (Western Expansion)	Forested ridge	Sept. 2 - Oct. 31	10	57	725	n/a	12.7	n/a	Woodlot Alternatives, Inc. 2005. Fall 2004 Avian Migration Surveys at the Proposed Deerfield Wind/Searsburg Expansion Project in Searsburg and Readsboro, Vermont. Prepared for Deerfield Wind, LLC and Vermont Environmental Research Associates.
Sheffield, Caledonia Cty, VT	Forested ridge	Sept. 11 - Oct. 14	10	60	193	10	3.2	(125 m) 31%[1]	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
Fall 2005									
Alabama, Genesee Cty, NY	Great Lakes plain/ADK foothills	Sept. 11 - Oct. 10	5	19	148	4	8.0	(125 m) 84.5%[1,2]	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
High Sheldon, Wyoming Cty, NY	Agricultural and wooded plateau	Aug. 29 - Nov. 4	8	53.5	168	9	3.1	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.

Project Site	Landscape	Survey Period	# of Survey Days	# of Survey Hours	Total # Observed	# of Species Observed	Seasonal Average Passage Rate (raptors/hr)	(Turbine Ht) and % Raptors Below Turbine Height	Reference
Wethersfield, Wyoming Cty, NY	Agricultural plateau	Sept. 13 - Sept. 18	3	21	0	0	0	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Bliss, Wyoming Cty, NY	Agricultural and wooded plateau	Sept. 12 - Sept. 17	2	21	0	0	0	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Cohocton, Stueben, Cty, NY	Agricultural plateau	Sept. 7 - Oct. 1	7	40.12	131	10	3.3	(125 m) 63%[1]	Woodlot Alternatives, Inc. 2005. Avian and Bat Information Summary and Risk Assessment for the Proposed Cohocton Wind Power Project in Cohocton, New York. Prepared for UPC Wind Management, LLC.
West Hill, Madison Cty, NY	Agricultural plateau	Sept. 6 - Oct. 31	11	65	369	14	5.7	(118 m) 51%[1]	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Clinton / Ellenburg, Clinton Cty, NY	Agricultural plateau	Sept. 23 - Sept. 28	3	21	0	0	0	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Altona, Clinton Cty, NY	Great Lakes plain/ADK foothills	Sept. 24 - Sept. 30	3	21	0	0	0	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Marble River, Clinton Cty, NY	Great Lakes plain/ADK foothills	Sept. 6 - Oct. 22	10	60	217	15	3.6	(120 m) 69%[1]	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation.
New Grange, Chautauqua Cty, NY	Forested ridge	Sept. 17 - Oct. 15	6	18	49	5	4.37 [3]	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Moresville, Deleware Cty, NY	Forested ridge	Aug. 31 - Nov. 3	11	72	228	11	3.2	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Dairy Hills, Wyoming Cty, NY	Agricultural plateau	Sept. 11 - Oct. 10	4	16	48	6	3.0	(125 m) 94.7%[1,2]	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Howard, Steuben Cty, NY	Agricultural plateau	Sept. 1 - Oct. 28	10	57	206	12	3.6	(91 m) 65%[1]	Woodlot Alternatives, Inc. 2005. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
Munnsville, Madison Cty, NY	Agricultural plateau	Sept. 6 - Oct. 31	11	65	369	14	5.7	(118 m) 51%[1]	Woodlot Alternatives, Inc. 2005. Summer and Fall 2005 Bird and Bat Surveys at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.

Project Site	Landscape	Survey Period	# of Survey Days	# of Survey Hours	Total # Observed	# of Species Observed	Seasonal Average Passage Rate (raptors/hr)	(Turbine Ht) and % Raptors Below Turbine Height	Reference
Mars Hill, Aroostook Cty, ME	Forested ridge	Sept. 9 - Oct. 13	8	42.5	115	13	1.5	(120 m) 58%[1]	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Mars Hill Wind Project in Mars Hill, Maine. Prepared for UPC Wind Management, LLC.
Lempster, Sullivan County, NH	Forested ridge	Fall 2005	10	80	264	10	3.3	(165 m) 20.8%[1]	The Louis Berger Group. 2006. Pre and Post-construction Avian Survey, Monitoring, and Mitigation at the Lempster, New Hampshire Wind Power Project. Prepared for Lempster Wind, LLC.
Clayton, Jefferson Cty, NY	Agricultural plateau	Sept. 9 - Oct. 16	11	63.5	575	13	9.1	(150 m) 89%[1]	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable.
Fall 2006									
Stetson, Penobscot Cty, ME	Forested ridge	Sept. 14 - Oct. 26	7	42	86	11	2.1	(125 m) 63%[1]	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Mountain Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V, LLC.
Wethersfield, Wyoming Cty, NY	Agricultural plateau	Sept. 21 - Nov. 11	3	21	231	11	9.7	(122 m) 27%[1]	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Chateaugay, Franklin Cty, NY	Great Lakes plain/ADK foothills	Sept. 6 - Oct. 26	2	24	42	5	1.6	(122 m) 31%[1]	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
St. Lawrence, Jefferson Cty, NY	Agricultural plateau	Sept. 23 - Nov. 11	10	30	288	10	9.6	(125 m) 81%***	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Cape Vincent, Jefferson Cty, NY	Great Lakes plain/ADK foothills	Sept. 23 - Nov. 11	10	30	165	10	5.5	(125 m) 72%	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
St. Lawrence, Jefferson Cty, NY	Great Lakes Shore	April 14 to May 12	4	12	91	8	7.5	(125 m) 81%[1,4]	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Jordanville, Herkimer Cty, NY	Agricultural plateau	Oct. 13 - Nov. 30	44	234.7	629	12	2.7	(125 m) 67%[1]	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Rollins, Penobscot Cty, ME	Forested ridge	Sept. 13 - Oct. 16	12	89	144	12	1.8	(120 m) 82%[1]	Stantec Consulting. 2008. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for First Wind, LLC.
Fall 2007									

Project Site	Landscape	Survey Period	# of Survey Days	# of Survey Hours	Total # Observed	# of Species Observed	Seasonal Average Passage Rate (raptors/hr)	(Turbine Ht) and % Raptors Below Turbine Height	Reference
Roxbury, Oxford Cty, ME	Forested ridge	Sept. 3 - Oct. 15	14	86	96	12	1.1	n/a	Stantec Consulting. 2008. Fall 2007 Migration Survey Report Visual, Acoustic, and Radar Surveys of Bird and Bat Migration conducted at the proposed Record Hill Wind Project In Roxbury, Maine. Prepared for Independence Wind, LLC.
Granite Reliable Power, Coos County, NH	Forested ridge	Sept. 5 - Oct. 16	11	68	44	9	0.7	n/a	Stantec Consulting. 2007. Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC.
Laurel Mountain, Preston Cty, WV	Forested ridge	Sept. 12 - Dec. 1	24	147	769	12	5.2	(125 m) 65%[1]	Stantec Consulting Services Inc. 2007. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia. Prepared for AES Laurel Mountain, LLC.
Greenland, Grant Cty, WV	Forested ridge	Sept. 12 - Dec. 1	27		858	13	5.9	(125 m) 67%[1]	Stantec Consulting Services Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the New Creek Wind Project, West Virginia. Prepared for AES New Creek, LLC.
New Grange, Chautauqua Cty, NY	Forested ridge	Sept. 21 - Oct. 28	6	n/a	n/a	n/a	4.4	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Allegany, Cattaraugus Cty, NY	Forested ridge	Sept. 8 - Oct. 11	11	63.78	125	10	2.0	(150 m) 78%[5]	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Jericho Rise, Franklin Cty, NY	Great Lakes plain/ADK foothills	Sept. 12 - Oct. 26	7	28	59	7	2.0	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Fall 2008									
Oakfield, Aroostook Cty, ME	Agricultural plateau	Sept. 26 - Oct. 14	12	84	60	8	0.7	(120 m) 67%[5]	Woodlot Alternatives, Inc. 2008. A Fall 2008 Survey of Bird and Bat Migration at the Oakfield Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC.
Moresville, Deleware Cty, NY	Forested ridge	Oct 14 - Dec 18	19	132	100	12	0.8	(125 m) 74%[5]	Stantec Consulting. 2009. 2008 Late-Fall Raptor Migration Survey Report. Prepared for Moresville Energy LLC.
Buckeye, Champaign Cty, OH	Agricultural plateau	Sept 1 - Nov 15	24	84	581	7	3.5	(150 m) 93%[1]	Stantec Consulting. 2009. Spring, Summer and Fall 2008 Bird and Bat Survey Report. Prepared for EverPower Wind Holdings, Inc.
Highland, Somerset Cty, ME	Forested ridge	Sept 3 to Oct 31	15	135	301	10	2.2	(128 m) 43%[5]	Stantec Consulting Services. 2009. Fall 2008 Bird and Bat Migration Survey Report: Radar and Acoustic Avian and Bat Surveys for the Highland Wind Project Highland Plantation, Maine. Prepared for Highland Wind LLC.
Fall 2009									
Granite Reliable Power, Coos County, NH (Dixville peak)	Forested ridge	Aug 27 to Oct 27	10	68.33	113	11	1.65	(125 m) 76%[5]	Stantec Consulting Services Inc. 2009. Summary of Fall 2009 Raptor Survey Results at the Proposed Granite Reliable Power Project. Prepared for Noble Environmental Power.
Granite Reliable Power, Coos County, NH (Owl head mtn)	Forested ridge	Aug 27 to Oct 27	10	70	129	10	1.84	(125 m) 82%[5]	Stantec Consulting Services Inc. 2009. Summary of Fall 2009 Raptor Survey Results at the Proposed Granite Reliable Power Project. Prepared for Noble Environmental Power.

Project Site	Landscape	Survey Period	# of Survey Days	# of Survey Hours	Total # Observed	# of Species Observed	Seasonal Average Passage Rate (raptors/hr)	(Turbine Ht) and % Raptors Below Turbine Height	Reference
Groton Wind, Grafton Cty, NH (Tenney ridge)	Forested ridge	Aug 24 to Oct 26	10	79	326	11	4.13	(121 m) 58%[5]	Stantec Consulting Services Inc. 2009. 2009 Spring, Summer, and Fall Avian and Bat Surveys for the Groton Wind Project. Prepared for Groton Wind, LLC.
Groton Wind, Grafton Cty, NH (Crosby and Bald Mtns)	Forested ridge	Aug 24 to Oct 26	10	78	370	14	4.74	(121 m) 79%[5]	Stantec Consulting Services Inc. 2009. 2009 Spring, Summer, and Fall Avian and Bat Surveys for the Groton Wind Project. Prepared for Groton Wind, LLC.
Stetson, Penobscot Cty, ME	Forested ridge	Sept 2 to Oct 14	8	50	45	11	0.9	n/a	Stantec Consulting. 2009. Stetson I Mountain Wind Project Year 1 Post-Construction Monitoring Report, 2009. Prepared for First Wind Management, LLC
Bowers, Washington Cty, ME	Forested ridge	Sept 9 to Oct 14	15	105	95	9	0.9	(119 m) 69%[1]	Stantec Consulting. 2009. Fall 2009 Avian and Bat Surveys for the Bowers Wind Project in Washington County, Maine. Prepared for Champlain Wind Energy, LLC.
Bull Hill, Hancock Cty, ME	Forested ridge	Sept 2 to Oct 14	12	87	124	11	1.43	(145 m) 98%[5]	Stantec Consulting. 2009. Summer and Fall 2009 Avian and Bat Survey Report for the Bull Hill Project in T16 MD, Maine. Prepared for Blue Sky East Wind, LLC.
Fall 2010									
Bingham, Somerset Cty, ME (Kingsbury Ridge)	Forested ridge	Sept 2 to Oct 13	12	84	57	11	0.68	(150 m) 85%[5]	Stantec Consulting Services Inc. 2010. 2010 Spring Avian and Spring/Summer Bat Surveys for the Bowers Wind Project. Prepared for Champlain Wind Energy, LLC.
Bingham, Somerset Cty, ME (Johnson Ridge)	Forested ridge	Sept 2 to Oct 13	5	35	61	9	1.74	(150 m) 92%[5]	Stantec Consulting Services Inc. 2010. 2010 Spring Avian and Spring/Summer Bat Surveys for the Bowers Wind Project. Prepared for Champlain Wind Energy, LLC.
Fall 2011									
Antrim, Hillsborough Cty, NH	Forested ridge	Sept 1 to Nov 20	21	147.5	978	10	6.63	(unknown) 37% between 50-500 ft above ground[1]	TRC Engineers and Stantec Consulting Services Inc. 2011. Avian and Bat Protection Plan for the Antrim Wind Energy Project. Prepared for Antrim Wind Energy, LLC.
Passadumkeag, Grand Falls Twp, ME	Forested ridge	Sept 9 to Oct 12	12	84	171	11	2.04	(140m) 58%[5]	Stantec Consulting Services Inc. 2011. Summer and Fall 2011 Avian and Bat Survey Report for the Passadumkeag Wind Project in Grand Falls Township, Maine. Prepared for Passadumkeag Windpark LLC.

[1] Percent below turbine height calculated for all observations within study area.

[2] Calculated for spring and fall combined.

[3] Non-migrants were not included in seasonal passage rates in NYSDEC 2008 table but were included in passage rates here.

[4] Calculated for spring and fall 2006 and 2007 combined.

[5] Percent below turbine height calculated for those observations within project area (locations within study area where turbines could possibly be located).

Appendix C

Potential Risk of Impact by Species

Appendix C Table 1. Nocturnally migrating passerines at increased potential risk of impact* due to collision during nocturnal migration at Wild Meadows Wind Project.

Species	Risk Factor	Exposure Pathway	Applicable information
Red-eyed vireo	Abundance and high mortality at existing wind farms in the east	documented occurrence in project area	commonly killed during nocturnal migration by collision with tall structures, among most common species killed at communication towers in Florida, 280 killed at one tower in a single night
			represented 9.6% of fatalities at Maple Ridge, NY (Jain *et al.* 2007), represented 30% of fatalities at Mountaineer, WV (Kerns and Kerlinger 2004), represented 25% of fatalities at Buffalo Mountain, Tennessee (Fiedler *et al*. 2007)
			Abundant and widespread across its range, BBS data suggest increasing populations in East (Cimprich *et al*. 2000)
Golden-crowned kinglet	relatively high mortality at existing facilities in the east	documented occurrence in project area	represented 39% of fatalities at Maple Ridge, NY (Jain *et al.* 2007) and 9% of fatalities at a wind farm in the Northeast (Stantec/Woodlot, unpublished data)
			relatively stable population in the east, though declines observed in the west (Ingold and Galati 1997)
Magnolia warbler	relatively high mortality at existing wind farms	documented occurrence in project area	relatively high mortality, represented 7% of total fatalities at Mountaineer (Kerns and Kerlinger 2004)
			fairly common fatalities at communication towers, over 1,000 found during 2 search days at a Wisconsin communication tower in 1963; and over 1,000 found at lighted buildings and wires in Texas (Hall 1994)
			BBS data indicate a relatively stable population (Hall 1994)
Rose-breasted grosbeak	relatively high mortality at existing facilities in the east	documented occurrence in project area	relatively high mortality at a wind farm in the east, represented 17% of fatalities at a wind farm in Tennessee (Fiedler *et al*. 2007)
			69 reported fatalities at communication towers in Florida over 25 years (Wyatt and Francis 2002)
			BBS data suggest a relatively stable population (Wyatt and Francis 2002)
Cedar waxwing	relatively high mortality at existing facilities in the east	documented occurrence in project area	6.9% of total avian mortality at Mount Storm Wind Energy Facility (Young *et al*. 2009)
			evidence of mortality during nocturnal migration from communication-tower strike (Witmer *et al.* 1997)
Cape May warbler	relatively high mortality at existing facilities in the east	documented occurrence in project area, nocturnal migrant	6.9% of total avian mortality at Mount Storm Wind Energy Facility (Young *et al.* 2009)
			evidence of mortality during nocturnal migration from communication-tower strike (Baltz and Latta 1998)
European starling	Abundance and high mortality at existing wind farms in the east	occurence in region; mostly diurnal migrant	relatively high mortality observed during Maple Ridge, NY 2008 monitoring season (Jain *et al*. 2008)
Vesper sparrow	species of conservation concern, high mortality at existing facilities in the U.S.	occurence in region	relatively low mortality at communication towers, overall 191 kills documented (Jones and Cornely 2002)
			relatively high mortality observed at existing sites in the West and Midwest, but in areas where relatively common (NRC 2007)
			BBS data suggest significant declines in Eastern region, likely due to loss of grassland or mowing of grassland habitat (Jones and Cornely 2002)
Black-throated green warbler	abundance	documented occurrence in project area	collision reported at existing facility in the Northeast (Stantec/Woodlot, unpublished data)
			BBS data suggests a relatively stable population range wide (Morse 2005)
Ovenbird	abundance	documented occurrence in project area	susceptibility to collision unknown
			BBS data suggest significant population declines (Van Horn and Donovan 1994)
Chestnut-sided warbler	abundance	documented occurrence in project area	hundreds known to collide with smokestakes, buildings, and communicaiton towers (Richardson and Brauning 1995)
			population generally showing slight decreases (Richardson and Brauning 1995)
American redstart	abundance	documented occurrence in project area	nocturnal migrant, known to collide with communication towers (Sherry and Holmes 1997)
			populations currently in fluctuation with unknown causes (Sherry and Holmes 1997)
Yellow-bellied sapsucker	species of conservation concern	documented occurrence in project area	nocturnal migrant, known to collide with communication towers (Walters *et al*. 2002)
			Appalachian region population declines (Walters *et al*. 2002)
Olive-sided flycatcher	species of conservation concern	occurrence in region	BBS data suggest broad-scale population declines in many physiographic regions (Altman and Sallabanks 2000)
			incomplete understanding of migration routes and population viability
White-throated sparrow	species of conservation concern	documented occurrence in project area	known to collide with communication towers and lighted buildings (Falls and Kopachena 1994)
			generally declining through most of range (Falls and Kopachena 1994)
Nashville warbler	species of conservation concern	documented occurrence in project area	over 100 birds known to collide with a 7 different communication towers on a single night (Williams 1996)
			population appears generally stable (Williams 1996)
Blackburnian warbler	species of conservation concern	documented occurrence in project area	relatively stable populations (Morse 2004)
			blackburnian warbler represented 9% of bird mortality at a wind farm in the Northeast (Stantec/Woodlot, unpublished data)
Black-and-white warbler	abundance	documented occurrence in project area	known to collide with wind turbines (Stantec, unpublished data)
			common and widespread, generally stable population (Kricher 1995)
Blue-headed vireo	abundance	documented occurrence in project area	relatively small numbers of collisions at communication towers during migration (James 1998)
			populations generally increasing (James 1998)
Northern flicker	abundance	documented occurrence in project area	primarily nocturnal migrant
			population generally declining (Moore 1995)
Wood thrush	species of conservation concern	documented occurrence in project area	reported collisions with communication towers and windows (Roth *et al*. 1996)
			population has been declining substantially across its range
Swainson's thrush	species of conservation concern	documented occurrence in project area	collisions with buildings and communication towers during migration considered source of significant mortality (Mack and Yong 2000)
			population generally declining (Mack and Yong 2000)

*RTE species in the region, species with high mortality rates at existing wind farms, species that exhibit flight behaviors that put them at increased risk, and species that have high abundance in the project area

Appendix C Table 2. Non-raptor breeding bird species at increased potential risk of impact* due to collision mortality at Wild Meadows Wind Project.

Species	Risk Factor	Exposure Pathway	Applicable information
Ovenbird	abundance	documented occurrence in project area, abundance, courtship flights	primarily low flights in forest, quick manuverability around trees (Van Horn and Donovan 1994)
			forages in leaf litter on the forest floor or in low vegetation (Van Horn and Donovan 1994)
			evening courtship display flights (Van Horn and Donovan 1994)
Rose-breasted grosbeak	relatively high mortality at existing wind farms in the east	documented occurrence in project area	forages in canopy and understory vegetation, occassionally on the ground (Wyatt and Francis 2002)
			BBS data suggest a relatively stable population (Wyatt and Francis 2002)
			relatively high mortality at a wind farm in the east, represented 17% of fatalities at a wind farm in Tennessee (Fiedler *et al.* 2007)
Red-eyed vireo	Abundance and high mortality at existing wind farms in the east	documented occurrence in project area, abundance	relatively high mortality among existing wind farms in the East (Jain *et al.* 2007, Kerns and Kerlinger 2004, Fiedler *et al.* 2007)
			Abundant and widespread across its range, BBS data suggest increasing populations in East (Cimprich *et al.* 2000)
			hops along branches in forest canopy or makes short flights in shrubby understory while foraging (Cimrich *et al.* 2000)
Common nighthawk	species of conservation concern	occurrence in region, foraging exposure	small numbers of mortality documented at communication tower sites (Poulin *et al.* 1996)
			males feed at heights up to 175m with spiraling downward descents (Poulin *et al*. 1996)
Chestnut-sided warbler	abundance	documented occurrence in project area	foliage gleaner, forages on the ground as well as in canopy, particularly in shrubby areas - hops and perches (Richardson and Brauning 1995)
			exhibits territorial and courtship chasing (Richardson and Brauning 1995)
			population generally showing slight decreases (Richardson and Brauning 1995)
Black-throated blue warbler	abundance	documented occurrence in project area	primarily low flights in forest, generally under canopy or quick tree-to-tree movements (Holmes *et al*. 2005)
			populations generally stable with highest breeding densities in forests with dense shrub layer (Holmes *et al.* 2005)
Chimney swift	species of conservation concern	occurrence in region, foraging exposure	ariel feeder at various heights above canopy; recorded at altitudes of 2,134 m (Cink and Collins 2002)
			courtship- and "trio-flights" recorded to 150 m (Cink and Collins 2002)
Blackburnian warbler	species of conservation concern	documented occurrence in project area	blackburnian warbler represented 9% of bird mortality at a wind farm in the Northeast (Stantec/Woodlot, unpublished data)
			males may perform courtship gliding (Morse 2004)
			forages in tall trees, rarely 'hawks' for insects (Morse 2004)
			relatively stable populations (Morse 2004)
Black-and-white warbler	abundance	documented occurrence in project area	foliage gleaner and bark creeper (Kricher 1995)
			territorial and courtship chasing (Kricher 1995)
			common and widespread, generally stable population (Kricher 1995)
Blue-headed vireo	abundance	documented occurrence in project area	populations generally increasing (James 1998)
			forages mainly at mid-tree height (James 1998)
			moves slowly and deliberately from perch to perch or tree to tree (James 1998)
			short distances territorial chasing (James 1998)
Northern flicker	abundance	documented occurrence in project area, abundance	population generally declining (Moore 1995)
			collisions with man-made objects not believed to be significant source of mortality (Moore 1995)
Magnolia warbler	relatively high mortality at existing wind farms	documented occurrence in project area	relatively high mortality, represented 7% of total fatalities at Mountaineer (Kerns and Kerlinger 2004)
			territorial displays occasionally involve chases and flights (Hall 1994)
			faily commonly collides with communication towers and buildings (Hall 1994)
			BBS data indicate a relatively stable population (Hall 1994)
			feeds mid-height in conifer trees and shrubs (Hall 1994)
black-capped chickadee	abundance	documented occurrence in project area, abundance	most flights are short and not significantly higher than canopy height
			BBS data suggest population is increasing in eastern range (Smith 1993)
Eastern wood-pewee	species of conservation concern	documented occurrence in project area	forages for insects by making sallie flights from subcanopy or canopy (Mccarty 1996)
			population generally stable (Mccarty 1996)
			relatively insensitive to fragmentation when choosing nesting sites (Mccarty 1996)
			territorial fighting and chasing and sexual chasing reported (Mccarty 1996)
Ruffed grouse	relatively high mortality at existing wind farms	occurrence in region, abundance	mortality has been observed at existing wind farms (Jain *et al*. 2007)
Wild Turkey	abundance	documented occurrence in project area, abundance	although not generally a high flier, turkeys don't have great manueverability in flight (Eaton 1992)
			3.4% of total avian mortality at Mount Storm Wind Energy Facility (Young *et al*. 2009)

*RTE species in the region, species with high mortality rates at existing wind farms, species that exhibit flight behaviors that put them at increased risk, and species that have high abundance in the project area

Appendix C Table 3. Non-raptor breeding bird species at higher potential risk of indirect effects due to loss of habitat or disturbance at Wild Meadows Wind Project.

Species	Risk Factor	Predicted Effect	Applicable information
Forest edge and early successional habitat			
Chestnut-sided warbler	Abundance	Increase in suitable habitat	responds positively to a variety of habitat changes, flourishes in clearcuts allowed to regenerate (Richardson and Brauning 1995)
			population generally showing slight decreases (Richardson and Brauning 1995)
American robin	Abundance	Increase in suitable habitat	increased in abundance prior to construction of VT facility (Kerlinger 2002)
			stable and increasing population in the east (Sallabanks and James 1999)
			land uses such as forest harvesting, agriculture, and urbanization have increased habitat (Sallanbanks and James 1999)
American redstart	Abundance and quality local habitat	Undetermined effect	prefers "mid-aged" succesional forest habitat, often moist or riparian and deciduous or deciduous-mixed canopy; does not appear to avoid edge (Sherry and Holmes 1997)
			displays "Area-sensitive" habitat choices in many parts of breeding range (Sherry and Holmes 1997)
Hermit thrush	Abundance	Increase in suitable habitat	a forest interior bird which favors interior edges, particularly at drier sites such as anthropogenic-, wind- and fire-openings (Jones and Donovan 1996)
			BBS data suggest positive population trends (Jones and Donovan 1996)
Black-capped chickadee	Abundance	Increase in suitable habitat	occurs in forests, open woods, thickets, edges of wooded areas, disturbed areas (Smith 1993)
			primarily arboreal foliage and bark gleaner
			BBS data suggest population is increasing in eastern range (Smith 1993)
			forest clearing increases forest edge habitat which benefits chickadees (Smith 1993)
Dark-eyed junco	Abundance	Little influence	a habitat generalist found in open woodlands (especially conifer), regenerating stands and edges (Nolan *et al.* 2002)
			forest-management and moderate anthropogenic disturbance generally has little influence in nesting or habitat use by juncos (Nolan *et al.* 2002)
Common yellowthroat	observed displacement at existing facility	Increase in suitable habitat, but potential behavioral displacement	observed to have decreased use of area surrounding turbines (100 m radius) at Buffalo Ridge, Minnesota (NRC 2007, Johnson *et al*. 2000)
			among species at Buffalo Ridge, Minnesota with observed displacement (Johnson *et al*. 2000)
			temporarily benefits from areas where thick vegetation growth is promoted by disturbance such as the removal of canopy (timber harvesting) (Guzy and Ritchison 1999)
			BBS data suggest slight population decreases in eastern region (Guzy and Ritchison 1999)
Forest habitat			
Ovenbird	Abundance	Decrease in suitable habitat	observed impacts from forest harvesting practices (NRC 2007)
			threatened by reduction of extensive tracts of forest and fragmentation (Van Horn and Donovan 1994)
			sensitive to cowbird brood parasitism (Van Horn and Donovan 1994)
			one of most abundant species prior to construction of the Searsburg, Vermont windfarm but suffered a decline in abundance after construction (Kerlinger 2002)
			BBS data suggest significant population declines (Van Horn and Donovan 1994)
Black-throated Blue Warbler	Abundance	Fragmentation of suitable habitat	breeds in relatively intact, mature northern hardwood forest, often montaine with shrubby understory (Holmes and Sillett 2005)
			area sensitive, occuring primarily in forest tracts > 100ha (Robbins *et al*. 1989); although found to frequently cross roads and habitat gaps (Harris and Reed 2002b)

Appendix C Table 3. Non-raptor breeding bird species at higher potential risk of indirect effects due to loss of habitat or disturbance at Wild Meadows Wind Project.

Species	Risk Factor	Predicted Effect	Applicable information
			forest interior birds found to have higher reproductive productivity than those breeding near edges, although due to pairing success in edge habitats, both seem to have similar probabilities of producing fledglings (Harris and Reed 2002a)
Red-eyed vireo	Abundance and high mortality at existing wind farms in the east	Decrease in suitable habitat, potential avoidance	populations apparently not impacted by small scale disturbances to habitat, were observed to tolerate small and narrow clearcuts of 2-10 hectares, larger scale clear-cuts have resulted in decreases in breeding populations (Cimprich *et al.* 2000)
			susceptible to cowbird brood parasitism (Cimprich *et al.* 2000)
			one of most abundant species prior to construction of the Searsburg, Vermont windfarm but suffered a decline in abundance after construction (Kerlinger 2002)
			disturbed by isolation of forest fragments, athough have been found breeding in fragments as small as 0.5 hectares (Cimprich *et al.* 2000)
			abundant and widespread across its range, BBS data suggest increasing populations in East (Cimprich *et al*. 2000)
Blackburnian warbler	Abundance	Decrease in suitable habitat	occurs in coniferous to coniferous-deciduous mixed forest primarily, often in late successional stands (Morse 2004)
			an interior-forest species sensitive to fragmentation and the removal of large conifers (Morse 2004)
Blue-headed vireo	Abundance	Decrease in suitable habitat	occurs in conifer and mixed forests, presence corresponds closely with areas where extensive forest predominates (James 1998)
			Because this species prefers areas of extensive forest, distribution limited by clearing and fragmentation (James 1998)
			populations generally increasing (James 1998)
			very sensitive to human activity during breeding, female may abandon nest and mate (James 1998)
Northern flicker	Abundance	Decrease in suitable habitat	prefers forest edge and open woodlands (Moore 1995)
			population generally declining (Moore 1995)
			sensitive to loss of snags, trees with dead limbs, and live trees with core rot for nesting (Moore 1995)
Chipping sparrow	Abundance	Increased vulnerability to brood parasites	prefers open, grassy coniferous forests, glades, or edges (Middleton 1998)
			clearing of forests, agriculture, creation of open grassy spaces benefits habitat (Middleton 1998)
			common and abundant population (Middleton 1998)
			clearing forests increases vulnerability to cow bird brood parasitism (Middleton 1998)
Wood thrush	Species of conservation concern	Decrease in suitable habitat	occurs in both desciduous and mixed forests, especially well-developed, upland, mesic ones (Roth *et al.* 1996)
			suceptible to fragmentation, significantly less abundant at edges bordered by paved road and powerlines than along narrow unpaved roads (Roth *et al.* 1996)
			will use fragments if intact canopy and dense understory occur, although susceptible to predation and brood parasitism (Roth *et al*. 1996)
			sensitive to nest abandonment if disturbances occur around the nest (Roth *et al*. 1996)
			population has been declining substantially across its range
*RTE species in the region, species with high mortality rates at existing wind farms, species that exhibit flight behaviors that put them at increased risk, and species that have high abundance in the project area			