7.0 WETLANDS, WILDLIFE AND FISHERIES

7.1 PROJECT AREA CONTEXT

Blue Sky West, LLC and Blue Sky West II, LLC (Applicants),[1] subsidiaries of First Wind Energy, LLC, have proposed construction of the Bingham Wind Project (project), a utility-scale wind energy facility in Bingham, Moscow, Mayfield Township, Kingsbury Plantation, Abbot, and Parkman, in Somerset and Piscataquis Counties, Maine (Figure 1). The project includes 62 turbines (63 potential turbine locations are being permitted) in Bingham, Kingsbury Plantation, and Mayfield Township capable of generating up to 191 megawatts (MW) of electricity. Other project features include upgrades to existing roads, and new roads, to access the turbines and crane paths; up to 5 permanent and up to 5 temporary meteorological (met) towers; an Operations and Maintenance (O&M) building in Mayfield Township; above and below ground 34.5 kilovolt (kV) electrical collector lines among the turbines (the majority of which will be buried alongside project roads) and connecting to a new collector substation in Mayfield Township; and an approximately 17-mile 115-kV generator lead connecting to an existing Central Maine Power Company (CMP) substation in Parkman, Maine. It is anticipated that a dynamic reactive device (DRD) such as a synchronous condenser will be required at the project collector substation to meet the interconnection requirements of ISO NE and CMP.

The ridgeline portion of the project area includes several low-elevation ridgelines and hills (i.e., below 1,800 feet in elevation), and the project is located in a landscape exclusively managed for commercial timber products. The generator lead corridor crosses an area of generally lower elevation (600 to 750 feet in elevation), which is primarily forested with small areas of timber management, agriculture, and sparse residential development. There is an extensive network of existing haul roads.

7.2 AGENCY CONSULTATION AND DATA COLLECTION

Prior to permitting activities for the project, Stantec Consulting (Stantec) sought information regarding potential environmental impacts from public resources. Initial agency consultation letters were sent to the Maine Department of Inland Fisheries and Wildlife (MDIFW), Maine Department of Environmental Protection (MDEP), and U.S. Fish and Wildlife Service (USFWS) to request information on any known occurrences of rare, threatened, or endangered (RTE) species or their habitats located in the vicinity of the planned project. The response letters and emails are included in Appendix A. In addition, Stantec reviewed publicly-available information about the existing natural communities and wildlife habitat in the project area.

Stantec conducted a variety of natural resource and wildlife field surveys in the vicinity of the project area. These pre-construction surveys provided data to help assess the project's potential to impact birds and bats, RTE plants and animals, breeding amphibians, and wetlands.

[1] Blue Sky West, LLC is the wind energy project entity; Blue Sky West II, LLC is the electrical generator lead entity.

These surveys included wetland delineations and wildlife surveys, as described below. The scope of the surveys was based on standard pre-construction survey methods within the wind power industry (i.e., guidelines outlined by the USFWS and MDIFW) and is consistent with other studies conducted recently in Maine and the Northeast. Stantec and the Applicant met on several occasions with representatives from both MDIFW and USFWS to confirm the scope and methodology for these surveys. In addition, several tours of the project area were conducted with agency representatives, and additional surveys (i.e., Canada lynx [*Lynx canadensis*] survey, fall 2011 radar migration surveys) were conducted based on feedback from the agencies.

From 2010 to 2013, Stantec completed ecological field surveys in association with the proposed project area that included:

- Wetland Delineations (2010, 2011, 2012, 2013);
- Vernal Pool Surveys (2010, 2011, and 2012);
- Northern Spring Salamander (*Gyrinophilus porphyriticus*) Surveys (Fall 2010 and Summer/Fall 2011);
- Bog Lemming (*Synaptomys borealis*) Surveys (Fall 2010 and Summer/Fall 2011);
- Roaring Brook Mayfly (*Epeorus frisoni*) Surveys (Fall 2010 and Summer/Fall 2011);
- Canada Lynx Habitat Assessment (Winter 2011 and Winter 2013), Winter Tracking, and Camera Surveys (Winter 2011);
- Deer Wintering Area (DWA) Surveys (Winter 2013);
- Aerial Bald Eagle (*Haliaeetus leucocephalus*) Nest Surveys (Fall 2009, Spring 2010, and Spring 2011);[2]
- Nocturnal Radar Migration Surveys (Spring 2010, Fall 2010, and Fall 2011);
- Acoustic Bat Surveys (Spring, Summer, and Fall 2010);
- Diurnal Raptor Migration Surveys (Spring and Fall 2010); and
- Breeding Bird Survey (Spring 2010).

This narrative provides an overview of the natural resources present in the project area and a summary of the natural resource impacts associated with the project. More detailed information about particular resources is found in the following exhibits.

-Exhibit 7A contains descriptions of the wetland, waterbody, and vernal pool resources within the project area.

-Exhibit 7B contains a summary of the wildlife habitat in the project areas.

-Exhibit 7C contains findings from the pre-construction RTE species surveys, Canada lynx assessments, bald eagle surveys, and DWA habitat surveys.

-Exhibit 7D describes the findings of the pre-construction avian, raptor, and bat surveys.

-Exhibit 7E describes the post-construction monitoring plan and curtailment plan.

[2] In addition, spring 2012 aerial nest surveys surrounding the project area were conducted by others. These survey results were provided by MDIFW and are included in Exhibit 7C-4.

7.3 PROJECT IMPACTS

Using the information gathered in these surveys, the project layout and footprint was designed to optimize engineering and wind resource conditions while minimizing environmental impacts to the maximum possible extent. The resource impacts have been further minimized through a multi-year iterative design in which the total project size was significantly reduced, and project elements were relocated to avoid and minimize resource impacts. The resulting resource impacts are summarized in the following Table 7.1.

Table 7.1. Summary of Environmental Impacts from Bingham Wind Project

Environmental Resource	Project Impact
Vegetation and Habitat	No RTE plant species identified. The project area is dominated by Beech-Birch-Maple Forest and Spruce-Northern Hardwoods Forest in various stages of regeneration following timber harvesting.
Wetlands	58,508.63 square feet (1.34 acres) of permanent wetland fill, 275,446.62 square feet (6.32 acres) of temporary wetland fill, and 34.35 acres of permanent cover type conversion.
Vernal Pools	No direct impacts to natural vernal pools. Clearing within the significant vernal pool habitat of four Significant Vernal Pools (SVPs). Total clearing (existing plus proposed) less than 25% of the SVP habitat. SVP_07AL_N: 24.3% SVP_50KN_and SVP_108SK_N: 23.97% SVP_53KN_N: 24.91%
Bald Eagle	The nearest active bald eagle nest is approximately 4.95 miles from the nearest proposed turbine location.
Canada Lynx	The project is located outside of the designated critical habitat for Canada lynx. Track of a single, apparently transient, male observed approximately 1.4 to 1.7 miles from the nearest components of the proposed project.
Atlantic Salmon	Much of the project is located within designated critical habitat for Atlantic salmon. No direct in-stream work is proposed within the project area. Clearing will occur within the vegetated stream buffers of 28 perennial streams.

Table 7.1. Summary of Environmental Impacts from Bingham Wind Project	
Mapped Deer Wintering Areas (DWA)	Clearing and wetland fill within four mapped DWAs for electrical generator lead and access roads: Clearing / Fill DWA #080604: 0.93 acres / 0 acres DWA #084029: 1.26 acres / 0.12 acres DWA #084031: 6.51 acres / 0.52 acres DWA #084033: 12.84 acres / 0.14 acres
Mapped Inland Waterfowl and Wading Bird Habitat (IWWH)	Clearing of 3.13 acres of IWWH #203972 habitat buffer for generator lead (clearing area overlaps with clearing within DWA #084031).
Northern Spring Salamander Habitat	No direct stream impact, but clearing within the associated stream buffer of 24 streams that provided potential habitat for northern spring salamanders.
Bog Lemming Habitat	No direct impact to wetland habitat where the bog lemming activity was observed, but a portion of the aboveground electrical collector line will be located approximately 600 feet to the south. Clearing is not expected to impact the hydrology of the habitat.
Birds	Passage rates for raptor migration and nocturnal migrants are consistent with other projects in the region.
Bats	Rates are consistent with other Maine sites. Turbines will be curtailed during certain periods of increased risk of collision.

7.4 WETLANDS AND STREAMS

The following is a brief summary of all wetland and waterbody resources identified within the project area.

- A total of 414 wetland resources regulated by the U.S. Army Corps of Engineers (Corps) and MDEP.
- A total of 67 streams within the project area, 36 of which are perennial.
- A total of 66 wetland resources are considered Wetlands of Special Significance. The majority of these resources are within 25 feet of a stream or have more than 20,000 square feet of open water or emergent vegetation.

A complete discussion of the methodology and results for the wetland and stream delineation and vernal pool surveys is included in Exhibit 7A.

7.5 VERNAL POOLS

Stantec completed vernal pool surveys in 2010, 2011, and 2012 under appropriate seasonal conditions. Based on these field surveys, a total of 58 vernal pools were identified within jurisdictional wetlands in the project area. Based on the definitions set forth in the Natural Resources Protection Act (NRPA), a vernal pool must be natural to be considered a Significant Vernal Pool (SVP). Of these 58 vernal pools, 13 are naturally occurring, and 4 meet the criteria to be considered an SVP under Chapter 335 of the NRPA.

A complete discussion of the methodology and results for the vernal pool surveys is included in Exhibit 7A.

7.6 FISHERIES

Stream delineation surveys identified 67 streams within the project area, 36 of which are perennial or have a perennial component (i.e., transition from intermittent to perennial).

Much of the project area occurs within the Piscataquis River watershed (HUC 0102000401), which is designated as critical habitat for Atlantic salmon (*Salmo salar*). The Gulf of Maine DPS of Atlantic salmon is federally listed as Endangered. Approximately half of the turbines and the entire generator lead corridor occur within this designated critical habitat. Several of the streams in Mayfield Township and Kingsbury Plantation, including Bigelow Brook and Bottle Brook, also are identified by MDIFW as valuable fisheries habitat for species such as wild brook trout (*Salvelinus fontinalis*). No in-stream work is proposed within the project area; however, clearing within the vegetated stream buffers of 34 perennial streams will occur (1 along the ridgeline and 33 along the generator lead and Route 16 portion of the aboveground collector).

A complete discussion of the methodology and results for the stream delineation surveys is included in Exhibit 7A. The Applicants have provided details of protection measures during construction to preserve surface water quality, that comply with state and federal requirements, which can be found in Section 10.

7.7 WETLAND AND STREAM IMPACTS

The wetland impacts associated with construction and operation of the project totals 1.34 acres of permanent wetland fill, 0 linear feet of stream impact for culverts, 6.32 acres of temporary wetland fill, and 34.35 acres of permanent cover type conversion. The impacts are in the following locations, which are summarized in Table 7.2 and described further in Appendix B.

Table 7.2. Bingham Wind Project – Wetland and Stream Impact Summary

Project Component	Permanent Fill (acres)	Wetland Clearing (acres)	Temporary Fill** (acres)	Stream Impact - Culvert (linear feet)
Roads*	1.33	0.31	0	0
Electrical Collector	0	3.81	0	0
Generator Lead Line	0.01	30.23	6.32	0
Other	0	0	0	0
Totals	1.34	34.35	6.32	0

*Road impacts include access roads on the project ridgeline and those along the generator lead line.
**Temporary fill represents temporary timber mats for construction.

Within the ridgeline portion of the project area, inclusive of the collector line, Stantec identified three SVPs: SVP_07AL_N, SVP_50KN_and SVP_108SK_N. One SVP, SVP_53KN_N, was identified along the generator lead. Impacts associated with construction of a project access road and an aboveground portion of the collector line combined with existing clearing will result in total clearing of the SVP habitat for SVP_07AL_N of approximately 24.3 percent. Clearing for the aboveground portion of the collector line combined with existing clearing will result in total clearing of the SVP habitat for SVP_50KN_and SVP_108SK_N of approximately 23.97 percent. Clearing for the generator lead line combined with existing clearing will result in total clearing of the SVP habitat for SVP_53KN_N of approximately 24.94 percent.

An alternatives analysis for the project, along with discussion of avoidance and minimization incorporated into the project design can be found in Section 1A.

7.8 WILDLIFE HABITAT

The project area is primarily dominated by a regenerating Beech-Birch-Maple forest and Spruce-Northern Hardwoods. This is a common forest habitat across the state, and as such, this habitat. There will be no blasting within 600 feet of the habitat, and for the collector line, only small localized charges or drilling will be used for pole placement.

7.9 SUMMARY: POTENTIAL IMPACT AND DESIGN CONSIDERATIONS

Table 7.2 provides a summary of impacts anticipated to occur within or in proximity to identified wildlife habitats. Impacts consist primarily of clearing associated with the aboveground portion of the collector line or the generator lead. Improvements to existing trails/roads also will require limited clearing and fill placement within three of the mapped Deer Wintering Areas. To the extent practicable, the project has been designed to avoid and minimize impacts to these wildlife habitats. Avoidance and minimization efforts included, but were not limited to the placement of structures, construction methods and maintenance methods. Section 1A of this permit application addresses in detail avoidance and minimization efforts. Section 10 of this permit application discusses the 7 basic types of habitat buffers proposed for the project and the clearing and maintenance practices that will be implemented to maintain each type of buffer. The following discussion addresses briefly avoidance and minimization efforts as well as project constraints that influenced these efforts.

Bog Lemming Habitat

As currently proposed the project will not directly impact the habitat where bog lemming activity was documented. The aboveground collector as it parallels the north side of Route 16 will cross approximately 600 feet south of this habitat, which will result in clearing of forested uplands and limited clearing of forested wetlands. Because of the distance and elevation difference between the bog lemming habitat and the proposed clearing, it is not anticipated that the project will impact the hydrology of this habitat.

Northern Spring Salamander and Atlantic Salmon Streams

No direct in-stream work is proposed within the project area, but clearing will occur within the existing vegetated stream buffers. One access road on the ridgeline will be constructed within 100 feet of a stream that represents good potential northern spring salamander habitat. This construction is necessary to replace a previously existing road that washed out when an upstream beaver dam failed. To the extent practicable, poles will not be placed within 100 feet of streams identified as documented/potential northern spring salamander habitat or those perennial streams within the designated critical habitat for Atlantic salmon. Only 28 total poles, 14 on the collector line and 14 on the generator lead, will be located within 100 feet of a perennial stream. In addition, buffers will be maintained along these streams to help protect water quality. In general, only "capable trees" (those expected to reach 15 feet) will be topped or removed within the buffers during construction and maintenance.

the project area includes many common wildlife species. See Exhibit 7B for a complete characterization of the area.

For the ridgeline portion of the project, two DWAs are present to the northwest and southeast of Johnson Mountain in Bingham and are located outside of the current project area. Two IWWHs occur within the ridgeline portion of the project area. One IWWH occurs in association with Withee Pond (UMO-10985) in Mayfield Township, and the other occurs north of Route 16 along Rift Brook (UMO-10813) in Mayfield Township. Each mapped IWWH consists of the wetland community typical utilized by waterfowl and wading birds (e.g., open water and emergent marsh) and a 250-habitat zone surrounding that utilized wetland community. There will be no direct impact to the wetland complex or the 250-foot zone surrounding either the Withee Pond IWWH or the Rift Brook IWWH. The southern edge of the 250-foot zone surrounding the Rift Brook IWWH overlaps with an existing gravel pit and Route 16. The aboveground portion of the proposed electrical collector line corridor will parallel the north side of Route 16 and will not impact the 250-foot IWWH habitat zone.

For the generator lead, four DWAs and one IWWH occur along the corridor. Table 7.3 provides a summary of approximate clearing for these five habitats. Impacts relate principally to crossing by the electrical generator lead. Impacts to DWA #084029 include construction of a segment of new road and upgrades to an existing road. Impacts to DWA #084031 will include clearing associated with upgrades to an existing road and DWA #084033 will include clearing associated with a new access roads. Details of the four DWAs impacted by the project can be found in the Deer Wintering Survey found in Exhibit 7C-4.

Correspondence from MDIFW identified one location in proximity to the project area where northern spring salamanders had been documented. The northern spring salamander is listed as a Species of Special Concern in Maine. During project specific field surveys, Stantec documented two streams within the project area where northern spring salamanders were observed or where surveys identified high quality habitat for the species. Northern spring salamander was documented in one stream, S021. In addition, 6 streams along the aboveground portion of the electrical collector corridor and 17 streams along the generator lead corridor were identified as potential habitat for this species. No direct in-stream work is proposed within the project area; however, clearing within the vegetated buffer of 24 of these streams will occur for one access road, for the aboveground portion of the electrical collector line, and for the electrical generator lead corridor.

During project-specific field surveys, Stantec documented one wetland (wetland MAY_W137) within the project area where bog lemming activity such as runways and tunnels, browsed and clipped vegetation, and fecal pellets were observed. The northern bog lemming is listed as Threated in Maine. This wetland is located north of Route 16 in Mayfield Township. The proposed project will not impact the habitat where the bog lemming activity was observed. The aboveground portion of the electrical collector line will be located approximately 600 feet to the south of the wetland. Clearing at this location will occur at a slightly lower elevation than the habitat where bog lemming activity was observed and is not expected to impact the hydrology of

The generator lead will bisect DWA #084033, crossing approximately 5,250 linear feet of the mapped habitat. The location of this proposed crossing is based on an agreement between the landowner and the Applicants, and an existing CMP easement that will be used for the project. The CMP easement, which will allow connection to the CMP substation in Parkman, is being used for the project because of non-participating landowners in the area. Because the generator lead will remove suitable softwood forest cover, it may impact deer winter cover and travel corridors and potentially fragment this existing habitat. To help reduce this impact, construction and maintenance will, to the extent practicable, only remove "capable trees" within the DWA habitat. A proposed project access road also will cross through the western edge of this DWA. Approximately 500 linear feet of the access road will be located with the DWA. This proposed project access road is a new road. Based upon Stantec 2013 surveys, the road is located in a portion of the DWA that lacks conforming softwood cover therefore impact to cover should be minimized.

Inland Waterfowl and Wading Bird Habitat

The generator lead will intersect one mapped IWWH, IWWH #203972, which is located within DWA #084033. As stated above, the location of this proposed crossing is based in part upon an agreement between the landowner and the Applicants. The proposed crossing will be located south of the existing marsh habitat, but does intersect a small open water area created by beaver (*Castor canadensis*) activity. Clearing for the collector will impact the forested habitat associated with this IWWH. To help reduce this impact, construction and maintenance will, to the extent practicable, only remove "capable trees" within the IWWH habitat buffer.

Table 7.3. Impacts within or in proximity to identified wildlife habitats or the buffers for the Bingham Wind Project[3]

Wildlife Habitat	**Project Impact**
Bog Lemming Habitat	No direct impact to wetland habitat where the bog lemming activity was observed, but a portion of the aboveground electrical collector line will be located approximately 600 feet to the south. Clearing is not expected to impact the hydrology of the habitat.
Northern Spring Salamander Habitat	No direct stream impact, but clearing within the associated stream buffer of 24 streams where northern spring salamander have been documented or that provided potential habitat for this species.

[3] Identified potential SVPs will be surveyed during the 2013 vernal pool season and impacts to the SVP habitat of these resources will be calculated based upon these survey results.

Vernal Pools

No direct impacts to natural vernal pool envelopes are proposed, and impacts to SVP habitats will be less than 25 percent at each of the four SVPs. These proposed impacts are principally associated with clearing for either the aboveground collector or generator lead corridor. Where possible, proposed project components have been placed within or in proximity to existing clearings. For example, SVP_07AL_N has an existing gravel road and gravel pit within its critical terrestrial habitat. The project will utilize this existing road with minor upgrades and the aboveground portion of the collector line will parallel the edge of this road and the gravel pit to minimize additional impacts. Similarly, the critical terrestrial habitat for SVP_50KN_N and SVP_108SK_N includes two existing gravel roads and Route 16. The aboveground portion of the collector line will closely parallel Route 16 and cross over the two gravel roads, which will reduce fragmentation and additional clearing.

Deer Wintering Areas

The generator lead will intersect four mapped DWAs. Based upon surveys conducted by Stantec in March 2013, no deer use was documented in two of these DWAs, DWA #080604 and DWA #084029. The other two DWAs, DWA #084031 and DWA #084033, would likely be considered moderate to high value based upon Stantec's surveys. Where possible, the proposed generator lead was designed to cross the edge of the mapped DWAs; however, in some instances, land access did restrict the location of these crossings.

The generator lead will cross approximately 500 linear feet in the northeastern corner of DWA #080604. The proposed clearing and placement of one pole is expected to have limited impact on the current habitat provided by this DWA. The generator lead will cross approximately 500 linear feet near the northwestern corner of DWA #084029. A project access road also will cross through the northwestern corner of this DWA. The project access road will include a segment of new road adjacent to Pease Bridge Road and upgrades to an existing road. The locations of both the generator lead and access road are based upon an agreement between the landowner and the Applicants. The proposed project activity is expected to have limited impact on the current habitat provided by this DWA.

The generator lead will bisect DWA #084031, crossing approximately 2,250 linear feet of the mapped habitat. The location of this proposed crossing is based in part upon an agreement between the landowner and the Applicants. Based upon Stantec's March 2013 surveys, the proposed crossing avoids the area with the highest percentage of conforming DWA canopy cover, which is located north of the crossing on either side of Gales Brook. Because the generator lead will remove some suitable softwood forest cover, it may impact deer winter cover and travel corridors and potentially fragment this existing habitat. To help reduce this impact, construction and maintenance will, to the extent practicable, only remove "capable trees" within the DWA habitat. A proposed project access road also will cross through the western edge of this DWA. Approximately 1,875 linear feet of the access road will be located within the DWA. This proposed project access road is an existing road/trail. Upgrading this existing road/trail will help minimize necessary clearing and grading, and habitat fragmentation.

Table 7.3. Impacts within or in proximity to identified wildlife habitats or the buffers for the Bingham Wind Project[3]	
Atlantic Salmon	Much of the project is located within designated critical habitat for Atlantic salmon. No direct in-stream work is proposed within the project area. Clearing will occur within the vegetated stream buffers of 28 perennial streams.
Vernal Pools	No direct impacts to natural vernal pools. Clearing within the significant vernal pool habitat of four SVPs. Total clearing (existing plus proposed) less than 25% of the SVP habitat. SVP_07AL_N: 24.3% SVP_50KN_and SVP_108SK_N: 23.97% SVP_53KN_N: 24.91%
Mapped Deer Wintering Areas (DWA)	Clearing and wetland fill within four mapped DWAs for electrical generator lead and access roads: Clearing / Fill DWA #080604: 0.93 acres / 0 acres DWA #084029: 1.26 acres / 0.12 acres DWA #084031: 6.51 acres / 0.52 acres DWA #084033: 12.84 acres / 0.14 acres
Mapped Inland Waterfowl and Wading Bird Habitat (IWWH)	Clearing of 3.13 acres of IWWH #203972 habitat buffer for generator lead (clearing area overlaps with clearing within DWA #084031).

7.10 COMPENSATION

The Applicants plans to mitigate unavoidable impacts associated with the project in accordance with Maine's Natural Resources Protection Act (NRPA) (38 M.R.S.A. § 480 A – BB) guidelines. The Applicants sought to minimize and avoid project impacts where practicable. In portions of the project where the impacts could not be avoided, the Applicants have evaluated multiple mitigation options but determined that they will satisfy the mitigation requirements via preservation.

The Applicants identified several candidate parcels adjacent to the project within the Upper Kennebec and Piscataquis watersheds that could serve as conservation parcels with appropriate acreages of resources with corresponding functions and values comparable to those being impacted by the proposed project. The candidate parcels are not only proximate to the project but also contain resources representative of those impacted in the ridgeline and generator lead development areas or "in kind "resources. The priority candidate parcels have been vetted for their risk of future development, and an effort to aggregate contiguous parcels and adjacency to protected lands with significant habitat is also a priority. Negotiations with the land owners and due diligence (i.e., review of available GIS data layers and site investigations) are currently underway. The Applicants plan to meet with the appropriate agencies in the short term to present the conservation parcels.

7.11 POST-CONSTRUCTION MORTALITY MONITORING

Fatality rates from other projects can be used as context when evaluating the possible level of impact at the proposed project. The rates observed at other facilities can be considered comparable to a proposed wind project if those projects are representative of the site being assessed (i.e., in the same region with similar landscape and project design characteristics). As described in Exhibit 7B, mortality estimates from post-construction monitoring conducted at 6 projects in Maine are now available, including Mars Hill, Stetson I, Stetson II, Rollins, Record Hill, and Kibby Mountain. In addition, results from other projects in forested landscapes in the Northeast are also available. Like those projects, Bingham is located on a previously harvested forested ridge; therefore, it can be expected that avian and bat mortality documented at the site would be relatively similar to that observed at these other projects.

The Applicants have proposed a post-construction monitoring protocol that is similar to those recently conducted for Rollins and Stetson. For a complete description of the protocol, refer to Exhibit 7E-1.

7.12 CURTAILMENT

To reduce the potential for bat mortality due to operation of the project, the applicant will curtail all 62 turbines, as described in Exhibit 7E-2.

Exhibit 7B: Wildlife Habitat Report

Wildlife Habitat Report

Bingham Wind Project
Bingham, Moscow, Mayfield Township, Kingsbury Plantation, Abbot, and Parkman
Somerset and Piscataquis Counties, Maine

Prepared for:

Blue Sky West, LLC and Blue Sky West II, LLC

First Wind
129 Middle Street,
3rd Floor
Portland, ME 04101

Prepared by:

Stantec Consulting

30 Park Drive
Topsham, ME 04086

April 2013

Stantec

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1.0 Introduction

Blue Sky West, LLC and Blue Sky West II, LLC (Applicants) have proposed construction of the Bingham Wind Project (project), a utility-scale wind energy facility with an installed generating capacity of up to 191 megawatts (MW). Turbines will be located along several ridgelines, which occur north and south of Route 16, in Mayfield Township, Kingsbury Plantation, Moscow, and Bingham, in Somerset and Piscataquis Counties, Maine (Figure 1). As currently proposed, the project includes approximately 62 turbines; associated access roads; up to 5 permanent meteorological (met) towers; an Operations and Maintenance (O&M) building; electrical collector system; an electrical substation; and an approximately 17-mile generator lead extending easterly to an existing Central Maine Power Company (CMP) substation in Parkman. It is anticipated that a dynamic reactive device such as a synchronous condenser will be required at the project collector substation to meet the interconnection requirements of ISO NE and CMP. Turbines will have a maximum height of 151.5 meters (m; 497 feet [ft]), and permanent met towers will be 104-meters (341 ft). In addition, up to 5 104-m temporary met towers may be installed at or near turbine locations before turbines are erected; however these temporary towers will be removed prior to the completion of construction. For a more detailed project description, please refer to Section 1 of this application.

The proposed project has the potential to affect wildlife species. The ridgeline portion of the project area falls entirely within lands actively managed for timber production, with forested habitats that are periodically harvested and a landscape that is crossed by an extensive network of logging roads. The proposed project will involve additional clearing of land for various project components and will result in temporary and permanent changes to habitat. Direct and indirect impacts to wildlife have the potential to occur during clearing, construction, and operation of the project. These direct and indirect impacts include injury, mortality, displacement, disturbance, or habitat loss. Direct impacts to birds and bats also could result from collisions with the project turbines during operation. To assess these potential impacts, detailed ecological surveys to identify available habitats and existing wildlife use of the project area were conducted.

In the course of project development, Stantec Consulting (Stantec) conducted a variety of ecological surveys in the project area. These pre-construction surveys provided data to help assess the project's potential to impact birds and bats; rare, threatened and endangered (RTE) plants and animals; breeding amphibians; and wetlands. The scope of the surveys was based on evolving standard pre-construction survey methods within the wind power industry (i.e., guidelines outlined by the U.S. Fish and Wildlife Service [USFWS] and Maine Department of Inland Fisheries and Wildlife [MDIFW]) and is consistent with other studies conducted recently within the State of Maine and the Northeast. Through consultation with the USFWS and the MDIFW, Stantec developed the scope and methodology for the bird and bat surveys that were conducted. At a March 5, 2010, meeting, the scope and methodology for these surveys were discussed and approved by the attending agency representatives. In addition, representatives from MDIFW and USFWS toured the project site on several occasions with the Applicants to discuss these studies and the corresponding results. The scope of work and methodology for species under federal jurisdiction, including Canada lynx (*Lynx canadensis*) and bald eagle (*Haliaeetus leucocephalus*), were developed and approved in coordination with the USFWS. Details regarding correspondence from the various natural resource review agencies, including Maine Department of Conservation Maine Natural Areas Program (MNAP; Section 9), MDFIW; USFWS; and Maine Department of Environmental Protection (MDEP) can be found in Section 7, Appendix A of this application.

Stantec conducted the following ecological field surveys between 2009 and 2013:

- Aerial Bald Eagle Nest Surveys (Fall 2009, Spring 2010, and Spring 2011);[1]
- Nocturnal Radar Migration Surveys (Spring 2010, Fall 2010, and Fall 2011);
- Acoustic Bat Surveys (Spring, Summer, and Fall 2010);
- Diurnal Raptor Migration Surveys (Spring and Fall 2010);

[1] Spring 2012 aerial nest surveys surrounding the project area were conducted by others, and these survey results were provided by MDIFW.

- Breeding Bird Survey (Spring 2010);
- Canada Lynx (*Lynx canadensis*) Habitat Assessment (Winter 2011 and 2013), Winter Tracking, and Camera Surveys (Winter 2011);
- Wetland Delineations (2010, 2011, 2012, 2013);
- Vernal Pool Surveys (2010, 2011, and 2012);
- Northern Spring Salamander (*Gyrinophilus porphyriticus*) Surveys (Fall 2010 and Summer/Fall 2011);
- Northern Bog Lemming (*Synaptomys borealis*) Surveys (Fall 2010 and Summer/Fall 2011);
- Roaring Brook Mayfly (*Epeorus frisoni*) Surveys (Fall 2010 and Summer/Fall 2011); and
- Deer Wintering Area (DWA) Surveys (Winter 2013).

In addition to conducting field surveys, Stantec reviewed public information about the existing natural communities in the project area. Information used to characterize the existing wildlife communities and their habitats included consultation with state agencies and review of available wildlife habitat databases and published natural resource classifications, including the Database of Essential Habitats and Sensitive Natural Areas, as categorized by MDIFW (http://megisims.state.me.us); Land Use Planning Commission (LUPC) Land Use Maps (http://www.maine.gov/doc/lupc/); and Natural Landscapes of Maine – A Guide to Natural Communities and Ecosystems (Gawler and Cutko 2010).

The following sections describe the dominant cover types found in the project area, the wildlife species that occur or are likely to occur within the project area based on the cover types present, and the potential for adverse impacts to wildlife and measures to minimize these impacts. Similar discussion for wetland resources and unusual natural areas can be found in application Exhibits 7A and 9A, respectively.

2.0 Ecological Setting of the Project Area

The project is located in the Central Mountains and Western Foothills biophysical regions (McMahon 1998). The ridgelines and hills in Mayfield Township, Kingsbury Plantation and Bingham fall within the Central Mountains Region or straddle the boundary between the Central Mountains and Western Foothills regions. The proposed generator lead crosses through the Western Foothills biophysical region. Although the Central Mountains Region includes some of the highest peaks in Maine, the physiography of the project area more closely represents that described for the Western Foothills Region. The Western Foothills Region is characterized by hilly terrain with elevations that average between 600 and 1,000 feet. The western boundary of this region generally marks the transition from temperate forest to boreal forest species.

The ridgeline portion of the project area includes several low-elevation ridgelines and hills (i.e., below 1,800 feet in elevation) located north and south of Route 16, including Johnson Mountain; unnamed hills north and northeast of Johnson Mountain; and an unnamed ridge north of Route 16 (Figure 1). The highest point on Johnson Mountain is approximately 455 m (1,500 ft), and the highest elevation within the project area north of Route 16 is approximately 538 m (1,775 ft). These ridgelines occur within a landscape managed exclusively for commercial timber products. A network of unpaved logging roads occurs throughout this portion of the project area. Stonewalls, foundations, and small family cemeteries, including the Adams and Clark cemeteries, are evidence of former homesteads and agricultural use of the area. Much of the evidence of these former homesteads is located in Kingsbury Plantation north of Kingsbury Pond, surrounding Old Mountain Road. Evidence of a commercial slate mining operation is present north of Route 16 along the west side of Bigelow Brook. The generator lead corridor crosses through an area of generally lower elevation; dropping to approximately 750 feet in elevation in southeastern Kingsbury Plantation to an elevation typically less than 600 feet across the remainder of the corridor. The current landscape is primarily forested with small areas of agriculture and sparse residential development.

3.0 Existing Cover Types and Wildlife Communities

Dominant land cover types dictate the wildlife communities in the project area. Climate conditions, geology, and past land use (i.e., forest harvesting are the most significant factors affecting the type and structure of the available habitats.

The project layout was designed to utilize existing roadways where possible and to avoid and minimize impacts to wetlands. Following are descriptions of the cover types and wildlife species that occur in the project area.

3.1. Forest Cover Types

Forests present within the project area include second and third-growth mixed native forests, early successional and regenerating forest stands, and plantations of both native and exotic tree species, including red pine (*Pinus resinosa*), Jack pine (*Pinus banksiana*), red spruce (*Picea rubens*), and hybrid larch trees (*Larix* spp.). Several recent timber management cuts that exceed 30 acres in size are scattered throughout the ridgeline area. The project area is dominated by Beech-Birch-Maple Forest and Spruce-Northern Hardwoods Forest (Gawler and Cutko 2010) types in various stages of regeneration following timber harvesting. Dominant trees present in these forested uplands include yellow birch (*Betula alleghenensis*), red spruce, American beech (*Fagus grandifolia*), and sugar maple (*Acer saccahrum*) with balsam fir (*Abies balsamea*), paper birch (*Betula papyrifera*), and striped maple (*Acer pennsylvanicum*) also present. The understory ranges from sparse to densely vegetated depending upon the successional stage of the area. Species present in the sapling and shrub layer include those tree species listed above, as well as beaked hazelnut (*Corylus cornuta*), hobblebush (*Viburnum lantanoides*) and northern mountain-ash (*Sorbus decora*). Canadian bunchberry (*Cornus canadensis*), hay-scented fern (*Dennstaedtia punctilobula*), wild sarsaparilla (*Aralia nudicaulis*), and evergreen wood fern (*Dryopteris intermedia*) dominate the herbaceous layer with bracken fern (*Pteridium aquilinum*), yellow bluebead-lily (*Clintonia borealis*), maystar (*Trientalis borealis*), painted wakerobin (*Trillium undulatum*), sessile-leaf bellwort (*Uvularia sessilifolia*), red raspberry (*Rubus idaeus ssp. idaeus*), and seedlings of tree species also present.

3.2. Wetlands

Wetlands in the project area were identified and delineated between 2010 and 2013. The complete report is included as Exhibit 7A. Forested, scrub-shrub, and emergent wetlands, as well as small to moderate-sized perennial and intermittent streams, are located throughout the ridgeline areas and along the generator lead corridor. Wetlands that occur on the ridgelines and hills are located primarily in topographic low points and drainages. Larger wetlands occur in areas of relatively moderate topography such as occurs between the northern end of Johnson Mountain and Route 16, and along the eastern portion of the generator lead. The generator lead corridor, which occurs at generally lower elevation than the ridgeline areas, includes a few larger perennial streams such as Kingsbury Stream and Gales Brook.

Forested wetlands are the most common wetland type, found throughout the ridgeline portion of the project area and along the generator lead. The canopy of these forested wetlands is dominated by red spruce, green ash (*Fraxinus pennsylvanica*), yellow birch, and northern white cedar (*Thuja occidentalis*) with a smaller component of balsam fir, black ash (*Fraxinus nigra*), and red maple (*Acer rubrum*). Several of the forested wetlands along the eastern portion of the generator lead corridor are dominated by northern white cedar and are characterized by relatively dense canopies and open understories.

Scrub-shrub wetlands are common throughout the project area, although not as prevalent as forested wetland communities. Scrub-shrub communities, particularly on the ridgelines, are previously forested wetlands that were altered by timber harvesting activities. Naturally occurring scrub-shrub communities are more generally found in association with the larger watercourses along the Route 16 collector line corridor and the generator lead corridor. The scrub-shrub wetlands that represent early successional forested wetlands are typically dominated by shrub and sapling sized tree species. Speckled alder is often dominant or co-dominant with the tree species, and other shrub species such as long-beaked willow (*Salix bebbiana*), pussy willow (*Salix discolor*), and white meadowsweet (*Spiraea alba)* also are present.

Emergent wetlands are common throughout the project area and often occur in previously forested areas that recently have been altered by timber harvesting activities. These types of emergent wetlands are typically referred to as wet meadows. These wetlands are dominated by herbaceous vegetation such as fowl manna grass (*Glyceria striata*), northeastern manna grass (*Glyceria melicaria*), Canada reed grass (*Calamagrostis canadensis*), nodding sedge (*Carex gynandra*), common woolsedge (*Scirpus cyperinus*), barber-pole bulrush (*Scirpus microcarpus*), cinnamon fern (*Osmunda cinamomea*), interrupted fern (*Osmunda claytoniana*), soft rush (*Juncus effuses*), spotted touch-me-not (*Impatiens capensis*), and common wrinkle-leaved goldenrod (*Solidago rugosa*). Naturally occurring emergent wetland communities are limited within the project area. Dominant vegetation within these naturally occurring emergent communities is similar to that found in the wet meadows.

Open water wetland communities within the project area are limited to two locations along the generator lead. These open water communities are part of larger wetland complexes that include forested components, as well as other wetland types located beyond the project limits.

3.3. Streams

Stantec identified 67 MDEP-jurisdictional streams within the project area. Twenty-nine streams within the project area are mapped by the U.S. Geological Survey (USGS), and seven of these are named, including Bigelow Brook within the ridgeline area, and Bottle Brook, Bear Brook, Cook Brook, Kingsbury Stream, Carlton Stream, and Gales Stream along the generator lead. Several of these streams in Mayfield Township and Kingsbury Plantation, including Bigelow Brook and Bottle Brook, also are identified by MDIFW as valuable fisheries habitat for species, including populations of wild brook trout (*Salvelinus fontinalis*). See Exhibit 7A, Appendix C, Table C-2 for a description of streams in the project area.

4.0 Wildlife Species

Following are brief descriptions of the predominant wildlife species known or suspected to occur in the project area. The information presented here was derived from extensive ecological field surveys conducted in the project area between 2009 and 2013.

Appendix A identifies the wildlife species observed within the project area, including those documented during targeted species-specific surveys or those observed incidentally during field surveys, or those expected to occur at the project based on their known range and habitat preferences. This matrix also identifies the general habitat categories each species would commonly use, and the expected season(s) of use (e.g., breeding, wintering).

4.1. Birds

<u>Breeding Birds</u>
Birds comprise one of the most abundant and diverse wildlife communities in the region, and the project area provides habitat for a variety of species. During spring 2010 breeding bird surveys, 50 species of birds, including those documented as incidental observations, were identified within the project area. Species with the greatest numbers of individuals detected during the spring 2010 surveys were white-throated sparrow (*Zonotrichia albicollis*), ovenbird (*Seiurus aurocapillus*), chestnut-sided warbler (*Dendroica pensylvanica*), and Nashville warbler (*Vermivora ruficapilla*). Of the 50 species documented during these surveys, 9 are listed in Maine as Special Concern. These are the least flycatcher (*Empidonax minimus*), eastern wood-pewee (*Contopus virens*), veery (*Catharus fuscescens*), American redstart (*Setophaga ruticilla*), black-and-white warbler (*Mniotilta varia*), Canada warbler (*Wilsonia canadensis*), chestnut-sided warbler, yellow-warbler (*Dendroica petechia*), and white-throated sparrow. For a complete description of the breeding bird surveys, refer to Exhibit 7D. Appendix A identifies those

bird species observed within the project area, as well as other species expected to occur based upon the available habitat and known species range.

Stantec conducted aerial nest surveys for bald eagles, osprey (*Pandion haliaetus*) and heron (*Ardea herodias*) rookeries in fall 2009, spring 2010 and spring 2011. Spring 2012 aerial nest surveys surrounding the project area were conducted by others and the results of these surveys were provided by MDIFW. Spring 2012 surveys identified an active bald eagle nest approximately 4.95 miles from the nearest proposed turbine location. This nest location was not active in 2010 and 2011; however, an alternate nest location for this pair of eagles, in close proximity to this nest, was active in 2011. No osprey nest sites or great blue heron rookery sites were identified in the search areas. For a complete description of these nest surveys, refer to Exhibit 7C-3.

Migratory Birds

Stantec conducted nocturnal radar migration surveys in spring 2010, fall 2010, and fall 2011 (Table 1). Flight heights (i.e., flight altitude above the radar location) were consistent with the results of other pre-construction surveys conducted at other locations in Maine. Although passage rates in fall 2010 and fall 2011 were at the high end of the range of other pre-construction surveys conducted in Maine and in the Northeast, the percent of targets below turbine height was within the range of fall survey results from these other projects (1% at multiple projects to 40% at a project in Hillsborough, New Hampshire). Comparative results are discussed further in Section 5.2.2 of this report. For a complete description and discussion of these surveys, refer to Exhibit 7D.

Table 1: Nocturnal radar migration survey summary. Spring 2010, Fall 2010 and Fall 2011.[2]

Season	Mean Passage Rate (targets per kilometer per hour)	Mean Flight Height (m)	Percent of Targets Below Turbine Height (152 m)	Flight Direction
Spring 2010	543 ± 30	355 ± 1	21	43° ± 51°
Fall 2010	803 ± 46	378 ± 1	20	234° ± 62°
Fall 2011	952 ± 63	397 ± 1	16	244° ± 50°

Stantec conducted raptor migration surveys from 2 locations in the project area (Kingsbury Ridge and Johnson Mountain) in spring and fall 2010. A total of 11 species of raptor were documented in the vicinity of the project area during raptor migration surveys; some of these species could potentially breed in the project area. Species observed during the surveys include American kestrel (*Falco sparverius*), bald eagle, broad-winged hawk (*Buteo platypterus*), Cooper's hawk (*Accipiter cooperii*), merlin (*Falco columbarius*), northern harrier (*Circus cyaneus*), osprey, peregrine falcon (*Falco peregrinus*) red-tailed hawk (*Buteo jamaicensis*), sharp-shinned hawk (*Accipiter striatus*), and turkey vulture (*Cathartes aura*). The use of the project area by state species of Special Concern (northern harrier and bald eagle) is anticipated to be largely during migration, and therefore infrequent and for short durations. For a complete description of these surveys, refer to Exhibit 7D.

[2] At the time of radar data analysis, the proposed turbine height was 152 meters. Given that the turbine height has decreased and as currently proposed is 150 meters, the percent below turbine height was not re-calculated for the reduced turbine height; it is expected that the percent below turbine height will decrease.

4.2. Mammals

Large mammals incidentally observed in the project area during project surveys include white-tailed deer (*Odocoileus virginianus*), moose (*Alces alces*), black bear (*Ursus americanus*), coyote (*Canis latrans*), and American marten (*Martes americana*). In addition, bobcat (*Lynx rufus*), fisher (*Martes pennanti*), and red fox (*Vulpes vulpes*) were documented during a winter camera survey. Canada lynx tracks were observed approximately 1.4 miles west of the project area during winter tracking surveys. For additional details related to this Canada lynx observation, refer to Section 4.4.7 of this report.

Medium-sized mammals incidentally observed within the project area include porcupine (*Erethizon dorsatum*), snowshoe hare (*Lepus americanus*), beaver (*Castor canadensis*), and river otter (*Lontra canadensis*). Small mammals incidentally within the project area include eastern chipmunk (*Tamias striatus*) and red squirrel (*Tamiasciurus hudsonicus*). The small mammal community also likely includes masked shrew (*Sorex cinereus*), pygmy shrew (*Sorex hoyi*), northern short-tailed shrew (*Blarina brevicauda*), deer mouse (*Peromyscus maniculatus*), and southern red-backed vole (*Clethrionomys gapperi*). Stantec conducted targeted surveys within the project area for bog lemming (*Synaptomys borealis*), a state-listed Threatened species. Based upon these surveys, bog lemming activity was documented in one wetland within the project area (See Section 4.4.4).

Eight species of bat also could occur in the area based upon their normal geographical range. These include the little brown myotis (*Myotis lucifugus*), northern long-eared myotis (*Myotis septentrionalis*), eastern small-footed bat (*Myotis lebeiii*), silver-haired bat (*Lasionycteris noctivagans*), big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), and tri-colored bat (*Perimyotis subflavus*).[3]

Stantec conducted acoustic surveys in spring-summer 2010 and fall 2010 to characterize bat activity in the project area. Eight bat detectors deployed in the three on-site met towers (Bessey, Crockett and Johnson met towers) and in two tree locations recorded calls of migrating or foraging bats in the vicinity of the project area. Of the calls that were identified to species guild, bats of the Genus *Myotis* were the most abundant bats documented during both the 2010 surveys. Other bat species/guilds that were documented include big brown /silver haired bat, hoary bat, and eastern red bat/tri-colored bat guilds. For a complete description of these surveys, refer to Exhibit 7D.

4.3. Amphibians and Reptiles

Amphibians and reptiles observed in the project area include spotted salamander (*Ambystoma maculatum*), dusky salamander (*Desmognathus fuscus*), northern two-lined salamander (*Eurycea wilderae*), northern spring salamander (a Special Concern species), northern redback salamander (*Plethodon cinereus*), wood frog (*Lithobates sylvatica*), bullfrog (*Rana catesbeiana*), green frog (*Rana clamitans*), gray treefrog (*Hyla versicolor*), eastern garter snake (*Thamnophis sirtalis*), and northern redbelly snake (*Storeria occipitomaculata*). Other common species likely to occur in the project area include American toad (*Bufo americanus*) and northern redback salamander (*Plethodon cinereus*). For a list of amphibian/reptile species observed in the project area during field surveys, refer to Appendix A.

4.4. Significant Wildlife Habitat

As defined by the Maine Natural Resource Protection Act (NRPA; M.R.S.A. 38 §480-B), Significant Wildlife Habitat includes the following resources as mapped by MDIFW or located within any other protected natural resource:

- Habitat for species appearing on the official state or federal list of endangered or threatened animal species;
- High and moderate value DWAs and travel corridors;
- Seabird nesting islands;

[3] Formerly known as the eastern pipistrelle (*Pipistrellus subflavus*).

- Critical spawning and nursery areas for Atlantic salmon (*Salmo salar*) as defined by the Department of Marine Resources;
- Significant Vernal Pool (SVP) habitat;
- High and moderate value inland waterfowl and wading bird habitat (IWWH), including nesting and feeding areas; and
- Shorebird nesting, feeding and staging areas.

The following identifies Significant Wildlife Habitats known or expected to occur within the project area. Also addressed are known or expected occurrences of species listed in the state of Maine as species of Special Concern that are not addressed elsewhere in this report.

4.4.1. Deer Wintering Areas and Inland Waterfowl and Wading Bird Habitat

Two DWAs identified to the northwest and southeast of Johnson Mountain in Bingham are located outside of the current project area, and will not be impacted by the proposed project. Two IWWHs occur within the ridgeline portion of the project area, and will not be impacted by the proposed project. One IWWH occurs in association with Withee Pond (UMO-10985) in Mayfield Township and the other occurs north of Route 16 near the electrical collector along Rift Brook (UMO-10813) in Mayfield Township.

Several Significant Wildlife Habitats, including four DWAs and one IWWH, occur along the generator lead. One DWA (#080604) located in Kingsbury Plantation will be crossed by the generator lead. DWA #084029 is located in Parkman along Carlton Stream. DWA #084031 extends from Route 15 in Abbot southeast to Crow Hill Road in Parkman. This DWA also includes a mapped IWWH (IWWH #203972) that straddles the Parkman/Abbot town line. The generator lead will cross DWA #084031 approximately 650 feet south of the Parkman/Abbot town line. DWA #084033 extends from the Parkman/Abbot and Parkman/Guilford town lines south to Harlow Pond and Manhanock Pond. The generator lead will cross east through the mapped habitat before turning southeast to the CMP substation. Refer to Exhibit 7C-4 for detailed survey results and maps.

4.4.2. Significant Vernal Pool Habitat

Stantec conducted vernal pool surveys in April and May 2010, which included the majority of the ridgeline portion of the project area. In May 2011, Stantec conducted vernal pool surveys along the generator lead extending from an unnamed ridgeline in Kingsbury Plantation east and southeast to the CMP substation in Parkman. An approximately four-mile long aboveground collector corridor located along the north side of Route 16 in Mayfield Township was added to the project in the fall of 2012. Much of this corridor was located outside of the 2010 vernal pool surveys limits. Wetlands within this aboveground collector corridor were delineated in the fall of 2012, and potential vernal pools (PVPs) were identified during the course of these delineations.

The purpose of the surveys conducted in 2010 and 2011 was to evaluate PVPs within the defined project area. The data collected during the surveys were used to determine if the pools met the criteria of an SVP as defined in Chapter 335 Section 9 of the NRPA.

Stantec identified 58 vernal pools within the project area. Thirteen of these vernal pools were determined to be naturally-occurring. The remaining 45 pools, which are located in all-terrain vehicle trails, borrow pits along gravel logging roads, or ruts made by logging equipment like skidders, were characterized as man-made. Each vernal pool identified is located within a jurisdictional wetland. Of the natural vernal pools identified, four were determined to be SVPs as defined by the NRPA. For a complete description of vernal pool surveys, refer to Exhibit 7A.

4.4.3. Northern Spring Salamander

In Maine, the northern spring salamander is listed as a species of Special Concern. Using information collected during project area delineations, a subset of the streams documented during wetland delineation efforts as exhibiting suitable habitat characteristics was selected to survey for this species. Based on Stantec's past experience with this species, northern spring salamanders prefer well-oxygenated perennial streams with a moderate to swift gradient, a rock-cobble-gravel-dominated substrate with low to moderate embeddedness of larger substrate materials, and a source generally above 800 feet in elevation. Stantec conducted surveys for this species on September 27-29, 2010, and September 12-15, 2011. Survey efforts involved turning over rocks and logs of various sizes within and adjacent to the stream, targeting habitat areas for both adults and larvae throughout the section of the stream located within and immediately adjacent to (i.e., within 250 feet of) the project area limits. Once a northern spring salamander was documented within a stream reach, survey efforts in that reach were considered complete.

During the 2010 surveys, no northern spring salamanders were documented within project area streams. During the 2011 surveys, northern spring salamanders were documented in one stream within the ridgeline portion of the project area. One additional stream within the ridgeline area had habitat characteristics very similar to known locations of northern spring salamanders. Although Stantec did not document northern spring salamanders within this stream, there is a high likelihood that they are present based on the habitat characteristics of the stream and are therefore assumed to be present.

The current location of the Route 16 section of the collector line and the location of the generator lead were not selected until after the completion of these surveys. Stantec ecologists reviewed subsequently collected wetland and stream delineation data and conducted a general landscape analysis to identify potentially suitable habitat within these corridors. Twenty-three streams were identified as containing potential habitat for the northern spring salamander. For a complete description of this survey, refer to Exhibit 7C-1.

4.4.4. Northern Bog Lemming

In Maine, the northern bog lemming is listed as Threatened. Stantec conducted surveys for northern bog lemming activity in late summer 2010 and 2011 to coincide with the anticipated peak seasonal activity. Two Stantec ecologists conducted meander surveys within potentially suitable habitats to locate and document evidence of bog lemming activity such as runways and tunnels through the peat moss (*Sphagnum* spp.), browse and clippings on graminoid vegetation, and fecal pellets. Because the northern bog lemming and southern bog lemming (*Synaptomys cooperi*) can only be definitively separated based upon enamel patterns on their lower teeth or through genetic analysis, any bog lemming activity was treated as if it indicated the presence of northern bog lemming. Stantec did not conduct trapping; therefore, it was not possible to determine if the observed activity was northern bog lemming or southern bog lemming. The field surveys were conducted on September 28-29, 2010 and September 14, 2011. During the 2010 surveys, bog lemming activity was identified in one wetland within the project area, as evidenced by well-defined runways and tunnels through peat moss and sedges, browsed and clipped three-seeded sedge (*Carex trisperma*) stems, and bright green fecal pellets. Based upon overlapping ranges of the southern and northern bog lemmings at this location and the relatively low elevation of the wetland where the bog lemming activity was observed (1,370 ft), it is possible that the observed activity could be attributed to the southern bog lemming. During the 2011 surveys, bog lemming activity was not observed in the surveyed wetlands within the project area. For a complete description of the bog lemming surveys, refer to Exhibit 7C-1.

4.4.5. Roaring Brook Mayfly

Stantec conducted field surveys for the Roaring Brook mayfly on September 13, 2011. Field surveys were conducted in accordance with the *DRAFT Recommended Survey Protocol for the Roaring Brook Mayfly* (Siebenmann and Swartz, September 16, 2010 and Siebenmann and Swartz, May 25, 2011), developed by MDIFW. Field surveys were conducted during the late summer to maximize the likelihood of obtaining final instar (i.e., pre-emergent) larvae of *Epeorus* species. During the 2010 surveys, no streams within the current project area were identified as containing potentially suitable habitat for Roaring Brook mayfly. During the 2011 surveys, one stream within the project area was identified as containing potentially suitable habitat for Roaring Brook mayfly. No *Epeorus* or dorsally-compressed mayfly species were collected in samples from this stream, indicating that the stream likely lacks sufficient sustained high energy flow. For a complete description of these surveys, refer to Exhibit 7C-1.

4.4.6. Bald Eagle

The bald eagle is listed as a species of Special Concern in Maine. Stantec conducted aerial nest surveys in the fall 2009, spring 2010 and spring 2011. Biologists from MDIFW conducted aerial nest surveys surrounding the project area in spring 2012. Based on the results of these surveys, there are no bald eagle nest locations within four miles of the proposed turbines. During the 2011 surveys, 3 active bald eagle nests were identified within 10 miles of the project area. In 2012, the closest active nest to the proposed turbine locations was nest 509B/C at approximately 4.95 miles. From the three years of spring surveys, this was the nearest active nest to the proposed project. For a complete discussion of the bald eagle surveys results, refer to Exhibit 7C-3.

4.4.7. Canada Lynx

Canada lynx is federally-listed as a Threatened species. Canada lynx were historically documented in Somerset County, and the project area occurs within approximately 25 miles of the southern limits of the species' designated critical habitat. Based upon this information, Stantec conducted an assessment of potential habitat, winter track surveys, and remote camera surveys, to assess the potential occurrence of Canada lynx within the vicinity of the project area. The habitat assessment and field surveys were conducted during the 2010-2011 winter season and included a one-mile buffer around the proposed turbine strings, as well as the remainder of Mayfield Township. In 2013, a second assessment of potential habitat was completed using more recent aerial photographs that more closely reflect current landscape conditions.

Because snowshoe hare (*Lepus americanus*) is the preferred prey species for Canada lynx, Stantec reviewed aerial photographs (i.e., conducted a desktop landscape analysis) to identity and qualify potential snowshoe hare habitat in the vicinity of the project area. The 2013 desktop analysis of 1-mile turbine buffer using 2011 aerial photography revealed 29 polygons (1,439 acres) of potential high value hare habitat, 97 polygons (2,145 acres) of moderate value hare habitat, and 69 polygons (1,572 acres) of future hare habitat (i.e., regenerating forest stands). Within the portions of Mayfield Township outside the 1-mile buffer and within the generator lead corridor, another 4,433 acres of habitat were identified. These include 41 polygons (1,779 acres) of potential high value hare habitat, 56 polygons (1,960 acres) of moderate value hare habitat, and 33 polygons (694 acres) of future hare habitat.

Stantec conducted Canada lynx snow track surveys at the project area and in the surrounding forest on three separate occasions on December 9 and 10, 2010, January 31, 2011, and March 23, 2011. A single Canada lynx track was observed on March 23, 2011. The observed track crossed a logging road in the northeastern corner of Mayfield Township where the cat had apparently emerged from Kingsley Bog, crossed the road, and continued northeast. The track location was in an area mapped by Stantec's 2011 desktop analysis as potentially moderate value habitat, approximately 1.4 to 1.7 miles from the nearest components of the proposed project. A scat sample was collected for DNA analysis and sent to U.S Department of Agriculture (USDA) Forest Service Rocky Mountain Research Station, Wildlife Genetics Lab for species determination, which found that the sample was from a male Canada lynx. Because only a single track was observed during the breeding season for this species, it is believed that the observation documented a transient male and that the surveyed area does not currently support a breeding population of Canada lynx.

In addition to the habitat analysis and tracking survey, Stantec conducted remote camera surveys to document the presence or the absence of Canada lynx. Stantec deployed 5 cameras on December 9, 2010, which remained in the field through March 23, 2011. No Canada lynx were detected with this camera survey. For a complete description of the lynx habitat assessment and results, refer to Exhibit 7C-2.

4.4.8. Atlantic Salmon

The Gulf of Maine Distinct Population Segment (DPS) of Atlantic salmon is federally-listed as Endangered. Much of the project area occurs within the Piscataquis River watershed (HUC 0102000401), which is designated as critical habitat for this species. No targeted post-construction fisheries surveys were conducted within the project area, although watercourses were mapped as part of wetland delineations. Approximately half of the turbines and the entire electrical generator lead corridor occur within this designated critical habitat. Several of the streams in Mayfield Township and Kingsbury Plantation including Bigelow Brook and Bottle Brook also are identified by MDIFW as valuable fisheries habitat for species including populations of wild brook trout (*Salvelinus fontinalis*). For a description of the streams within the project area, refer to Exhibit 7A, Appendix C.

5.0 Potential Project Impacts to Habitat and Wildlife

The construction and operation of wind turbines at the project will result in direct and indirect impacts to local wildlife communities and their habitats. In general, impacts could include habitat conversion, as well as collision-related fatalities. The following discusses the potential project impacts that could affect the natural resources and wildlife groups, based on the findings of on-site field surveys.

5.1. Habitat Conversion

The project was designed to avoid wetlands to the greatest extent possible, and the proposed turbines and associated access roads will be located principally within previously disturbed upland forests. Where possible, existing access roads will be used to provide construction and operational access to the project. The project also will take advantage of existing clearings where possible for turbine locations and construction laydown areas. The project will include the direct loss of some forested uplands and wetlands, and the conversion of some forested habitats to earlier-successional habitats.

The development of the project will require the construction of turbine structures, new roads, and an electrical collector system. Each wind turbine will be located in an opening that will be graded relatively flat and, after construction, all but approximately 0.35 acres will be allowed to revegetate to herbaceous and shrub covers. The road system needed to construct the project requires that roads have a travel surface of 35 feet wide on the ridgeline for the passage of the crane needed to erect the turbines. All other roads will have a travel surface of up to 24 feet wide.

For local wildlife, the direct loss of habitat will occur from the conversion of vegetated habitats to permanent roads and turbine clearings. Potential indirect effects also may include disturbance during and following construction of the project. This could result in short-term avoidance of the area by some individual animals or species, or possible longer-term avoidance by some species. In contrast, some species may target the converted early successional habitat for use. These changes will affect local wildlife use, but in part because current wildlife populations have historically adapted to rapid habitat changes associated with timber management activities, the habitat conversion associated with the project is not expected to adversely affect local wildlife populations.

Specific impacts to identified wildlife habitats will include:

- **SVP_07AL_N significant vernal pool habitat**: Impacts associated with construction of a project access road and an aboveground portion of the collector line combined with existing clearing will result in total clearing of the SVP habitat of approximately 24.3 percent.
- **SVP_50KN_and SVP_108SK_N significant vernal pool habitat**: Clearing for the aboveground portion of the collector line combined with existing clearing will result in total clearing of the SVP habitat of approximately 23.97 percent.
- **SVP_53KN_N significant vernal pool habitat**: Clearing for the generator lead line combined with existing clearing will result in total clearing of the SVP habitat of approximately 24.94 percent.
- **Northern spring salamander stream buffers**: No direct in-stream work is proposed within the project area; however, clearing within the vegetated buffer of 24 streams with suitable northern spring salamander habitat will occur for one access road, for the aboveground portion of the electrical collector line and for the electrical generator lead corridor.
- **Northern bog lemming habitat buffer**: The proposed project will not directly impact the one habitat where bog lemming activity was observed, but a portion of the aboveground electrical collector line will be located approximately 600 feet to the south. Clearing at this location will occur at a slightly lower elevation than the habitat where bog lemming activity was observed and is not expected to impact the hydrology of this habitat. Blasting will be required but would be limited to small local charges for pole placement.
- **Atlantic salmon stream buffers:** No direct in-stream work is proposed within the project area; however, clearing within the vegetated stream buffers of 28 perennial streams will occur.

Impacts within mapped DWA and/or the 250-foot habitat zone associated with mapped IWWH are summarized in Table 2.

Table 2. Summary of Impacts within Mapped DWA and/or the 250-foot Habitat Zone Associated with Mapped IWWH.

Habitat ID	MDIFW Rating	Town or Township	Habitat Impact	Approximate Area of Clearing (acres)	Approximate Fill Associated with Generator Lead Access Roads (acres)	Comments
IWWH #10985	Moderate	Mayfield Township	No impact	0	0	IWWH associated with Withee Pond. Total IWWH area 65 acres
IWWH #10813	Moderate	Mayfield Township	Principally forested upland	0	0	IWWH associated with Rift Brook. Total IWWH area 55 acres
DWA #080604	Not available	Kingsbury Plantation	Principally forested uplands	0.93	0	Total DWA area 166 acres
DWA #084029	Not available	Parkman	Forested uplands and forested wetlands	1.26	0.12	Associated with Carlton Stream Total DWA area 21 acres
DWA #084031	Not available	Parkman	Forested uplands and forested wetlands	6.5	0.52	DWA extends from Route 15 in Abbot southeast to Crow Hill Road in Parkman. Total DWA area 445 acres
IWWH #203972	Moderate	Parkman	See DWA #084031	See DWA #084031	0	Occurs within DWA #084031. Total IWWH area 81 acres
DWA #084033	Not available	Parkman	Principally forested wetlands and forested uplands	12.84	0.14	DWA extends from the Parkman/Abbot and Parkman/Guilford town lines south to Harlow and Manhanock ponds. Total DWA area 510 acres

To the extent practicable, clearing within DWA and IWWH habitats and habitat buffers will be minimized. Section 10 of this permit application discusses the eight basic types of buffers proposed for the project and the clearing and maintenance practices that will be implemented to maintain each type of buffer.

5.2. Collision Risk

It is known that birds and bats collide with tall structures, such as buildings, communications towers and wind turbines. Because wind turbines are large, have moving parts and extend above the surrounding landscape, the potential exists for wildlife collisions to occur. However, mortality surveys conducted at operational wind projects in the U.S. have found that collision risk is generally low when compared to other sources of bird mortality and to mortality from other energy sources (i.e., fossil fuels and nuclear power). Further, a recent summary of avian mortality at communication towers suggests that, for 177 bird species for which collision and population trend data is available, there is no correlation between collision vulnerability and annual rate of population change indicating that this source of mortality has no observable effect on these populations (Arnold and Zink 2011). In fact, many of the species involved in collisions with manmade structures have increasing population trends (Arnold and Zink 2011), suggesting that collisions involve regionally abundant species. Table 3 provides a summary of estimates of known sources of bird mortality.

Table 3. Summary of Nation-Wide Bird Mortality Estimates

Structure/Cause	Total Bird Fatalities	Reference
Building and Windows	1 billion	Klem 1990
Power Lines	10,000 - 174 million	Erickson et al. 2001
Housecats	1.4 – 3.7 billion	Loss et al. 2012
Vehicles	60 - 80 million	Erickson et al. 2001
Agricultural Pesticides	67 million	Pimentel and Acquay 1992
Communication Towers	25 million	Longcore et al. 2012
Wind Generation Facilities	10,000 - 40,000	Erickson *et al.* 2001

5.2.1. Measurement of Avian Mortality and Comparability

The original concern that wind development-induced fatalities could pose biologically significant impacts to bird populations arose from a few facilities, mainly Altamont Pass and Solano County Wind Resource Areas in California [Altamont Pass; Orloff and Flannery 1992, Hunt 2002]). For example, numerous raptor fatalities, particularly of golden eagles (*Aquila chrysaetos*), were documented at the Altamont Pass site. The closely spaced early-model turbines used at Altamont Pass were on relatively short pedestals placing the blades close to the ground where golden eagles were actively hunting preferred prey species, in particular California ground squirrel (*Spermophilus beecheyii*) (Hunt 2002).

In response to potential impacts, post-construction monitoring plans are typically developed in consultation with state and federal agencies. Such plans detail field methodology in terms of timing, proportion of turbines to search, size of search areas, and search interval. Plans also specify how fatality estimates are calculated statistically, and how correction factors are incorporated. For example, plans typically include the results of searcher efficiency trials, in which the observer is tested to help assess what percent of carcasses the observer actually finds, and results of carcass persistence trials, which assess how long carcasses persist on the ground before being scavenged and are available to be discovered. Carcass persistence trials also can be used to validate the length of the study's search interval, to determine if the majority of carcasses are expected to remain on the ground between search intervals.

It is important to acknowledge that fatality estimation methods are evolving, and fatality estimates, which are generally expressed as fatalities per turbine or per MW, between sites must be compared with caution because differences in methodology, estimators, or overall survey goals occur. These types of mortality studies are designed to sample peak periods of collision risk for birds and bats at a representative sample of turbines, with the ultimate goal of estimating the level of take over the course of a study period. In this respect, these estimates are indices of the level of impact to birds and bats from individual projects. These indices can best be compared with similar field methodology used at sites with similar physical and landscape characteristics (i.e., forested ridgeline, agricultural field).

Bird and bat fatality study protocols at existing wind farms in Maine (Mars Hill, Stetson, Kibby, Rollins, and Record Hill) and New Hampshire (Lempster) have been developed in consultation with the respective state and federal agencies. Other states such as New York (NYSDEC 2009) and Pennsylvania (PGC 2007) have developed guidelines for post-construction monitoring methods for which study work plans can be developed in a uniform manner. While study protocols have been tailored to address individual project study objectives, post-construction studies in Maine and New Hampshire have included the following key elements: searches under turbines (either a subset or all turbines), searcher efficiency trials, carcass persistence trials, and statistical analysis to estimate total mortality during a study period.

These studies have generally been conducted from mid-April to mid-October (sometimes with a break in June), to cover spring migration, the summer breeding period, the late-summer bat activity period, and the fall migration period. The majority of studies in Maine and New Hampshire have used a weekly search interval where individual turbines are searched every 7 days. The advantage to a weekly search interval versus a daily search interval is the feasibility of including a larger number of turbines (depending on the size of the project) in searches. The appropriate search interval (weekly or daily) would depend on survey objectives, as well as scavenger activity at a project. Weekly searches are adequate if 1) the objective is to determine estimates, or indices, of take that can be compared to most other available studies, and 2) if a reasonable number of carcasses remain to be found within the weekly search interval (as determined by carcass persistence trials).

Turbine searches at forested ridgeline projects in Maine and New Hampshire have involved searching the areas leveled for turbine lay-down (typical plot diameter of 75 m) with linear transects established 3 to 5 m apart (depending on vegetation cover). For those wind projects in landscape settings where searching a greater area is feasible, such as agricultural landscapes in New York, search areas are typically as large as 120 square meters (m^2) (14,400 m^2) where 120 m represents the maximum rotor-swept height of most modern turbines. Some carcasses may land outside of the 75 m average diameter turbine lay-down area at projects on forested ridgelines; however, studies at sites with larger search plots have indicated that the majority of carcasses are found closer to turbine bases. For example, a study at the Maple Ridge Wind Project in New York that included search areas of 120 m by 130 m indicated that the mean distance birds and bats were found from tower bases was 39 m and 26 m, respectively (Jain et al. 2009). For those projects with exceptionally small search areas (e.g., Lempster, New Hampshire), search area correction factors based on the distribution of carcasses found within search areas may be applied to account for some of the carcasses that may have landed outside of search plots.

Vegetation cover within plots also influences the percent of carcasses that may be found by searchers. Studies may involve vegetation management to increase searcher efficiency rates. Alternatively, an emerging method of fatality estimation includes vegetation visibility class mapping within the search plots to account for variable searcher efficiency in different vegetation cover types. This method provides a gradation of "correction factors" that are applied to the actual number of carcasses found, resulting in what is presumably a more accurate (and greater) estimate of fatality than if vegetation classes are not accounted for. It should be noted, however, that the use of this method during some of the more recent studies creates another difference with older studies, making them not perfectly comparable across sites.

5.2.2. Review of Known Collision Risk

Birds

In 2004, raptor mortality estimates at Altamont Pass were 0.24 raptor fatalities per turbine per year (fatalities/turbine/year), or 1,296 raptor fatalities annually (GAO 2005). Altamont Pass and Solano County Wind Resource Areas are located along migratory 'bottlenecks' or sites where birds were seasonally very active. Studies conducted at those California facilities that experienced high fatality rates found significant contributing factors to the high mortality observed: the number, density, and physical characteristics of turbines (over 5,000 turbines present at Altamont Pass alone); high raptor wintering density; high prey densities within the wind resource areas; and the funneling of migrants through these areas by topographical features. Additionally, the turbines are predominantly older generation turbines that are smaller, lower to the ground, and with blades that spin faster as wind speed increases. Turbines at these sites also are spaced very close together in comparison to more modern facilities with larger turbines. Finally, most turbines are placed on lattice-type towers, which could provide perch locations in proximity to spinning blades.

Raptor mortality in the U.S., outside of California, has been documented to be very low. Mortality rates found at onshore wind developments outside of Altamont Pass have documented 0 to 0.07 raptor fatalities/turbine/year from 2000-2004 (GAO 2005). Results of roughly 30 studies at over 25 different locations throughout the U.S. (outside California) have documented approximately 50 total raptor fatalities (Appendix B Table 1). This compares with more than 100 raptor mortalities documented per year at Altamont Pass and overall estimates of thousands killed annually at that facility.

Documented flight heights of raptors migrating through a project area does not correlate to collision risk, particularly since raptors frequently exhibit avoidance behavior, probably due to their propensity to migrate during daylight hours under clear weather conditions. Studies have documented high raptor and eagle collision avoidance behaviors at modern wind facilities (Whitfield and Madders 2006, Chamberlain et al. 2006, Sharp et al. 2011, Stantec 2013). As most raptors are diurnal, raptors are able to visually, as well as acoustically detect turbines during periods of fair weather. Foraging raptors that may become distracted by prey, resident young birds that are learning to fly, or migrant raptors flying during periods of reduced visibility, may be at increased risk of collision with wind turbines.

Songbirds (e.g., warblers, vireos, thrushes, sparrows) account for up to 80 percent of known fatalities reported at wind facilities (Johnson et al. 2000, Erickson et al. 2002). Species that migrate long distances and/or migrate at night have been found to be at greater risk of collision with manmade structures than diurnal migrants or year-round resident species (Arnold and Zink 2011). While mortality of these species has included both daytime and nocturnal fatalities (Erickson et al. 2001), collisions are more likely to occur at night particularly during periods of low visibility resulting from inclement weather. Publicly available results (not accounting for search area corrections) of recent studies at 15 wind projects in the northeastern U.S. (Maine, New Hampshire, Vermont, New York) estimate fatality rates between 0.44 to 2.5 birds/turbine/year (Mars Hill, Maine; Stantec Consulting 2008) and 9.48 birds/turbine/year (Maple Ridge, New York; Jain et al. 2007) (Table 4; Appendix B Table 2).

See Table 4 for estimated fatality results for bats and birds at Maine projects.[4] Projects in Table 4 used comparable post-construction monitoring methodologies developed in consultation with USFWS and MDIFW.

[4] See Appendix B Table 2 for additional details of the fatality studies at these projects.

Table 4. Estimated fatalities for birds and bats at operational projects in Maine.

Project	Year	Estimated Bat Fatalities/Turbine/ Period (Estimated total bat fatalities)	Estimated Bird Fatalities/Turbine/Period (Estimated total bird fatalities)	Source
Mars Hill	2007	0.43 - 4.40 (12-123)	0.44 - 2.5 (27-69)	Stantec Consulting 2008
Mars Hill	2008	0.17 - 0.68 (5-19)	2.40 - 2.65 (57-74)	Stantec Consulting 2009
Stetson I*	2009	2.11 (80)	4.03 (153)	Stantec Consulting 2010
Stetson I	2011	0.43 (16)	1.77 (67)	Normandeau Associates 2010a
Stetson II	2010	2.48 (42)	2.14 (36)	Normandeau Associates 2010b
Stetson II	2012	2.06 (36)	2.83 (49)	Stantec Consulting 2012a
Rollins	2012	0.18 (7)	2.94 (118)	Stantec Consulting 2012b
Kibby	2011	0 spring; 0.37 fall (16)	0.72 spring (32); 0.29 fall (12)	Stantec Consulting 2011
Record Hill	2012	6.78 (150)	8.46 (187)	Stantec Consulting 2012c

Bats

Emerging evidence suggests that migratory bats are at a greater risk of turbine collisions than birds, particularly in certain areas of the country. This concern arose mainly from a study at the 44-turbine Mountaineer Wind Energy Facility in Tucker County, West Virginia where 475 dead bats (47.5 bats/turbine/year) were documented, the majority (92.5%) which were found between August 18 and September 30, 2003 (Kerns and Kerlinger 2004). A 2009 post-construction study at the Blue Sky Green Field project in Wisconsin documented an unprecedented, high mortality rate for the Midwest, with total estimated mortality of 40.5 bat fatalities per turbine (Gruver 2009). At a 56-turbine facility southeast of Lubbock, Texas, observers found 47 Brazilian free-tailed bats, an abundant species, from September 2006 to September 2007 (Miller 2008). At a 68-turbine facility in northwestern Oklahoma, 95 Brazilian free-tailed bats were found (Piorkowski 2006). These and similar subsequent studies have raised concerns that bat mortality associated with wind turbine collisions could adversely impact bat populations (Williams 2003; GAO 2005; Arnett et al. 2008; Kunz et al. 2007a).

As of 2008, there were 11 species of bats reported as fatalities at projects in the U.S. (Arnett et al. 2008); however, Indiana bat has since been documented as a fatality at a project in Indiana (West 2011) for a total of 12 bat species reported in the US. Mortality of eight bat species has been documented at wind energy facilities specifically in the eastern U.S. (Kunz et al. 2007b), with most fatalities occurring during what is generally considered the fall migration period of August to November (Arnett et al. 2008, Cryan 2003, Cryan and Brown 2007, Johnson et al. 2005). Species documented under turbines in the East include little brown myotis, northern myotis, tri-colored bat, Seminole (*Lasiurus seminolus*), silver-haired, hoary, red, and big brown bats. In North America, migratory tree roosting bat species represent about 75 percent of documented bat fatalities, and hoary bats specifically represent about half of all bat fatalities (Arnett et al. 2008).

Mortality estimates for bats in Maine are far lower than those documented at other projects in the East and in other regions of the U.S. Post-construction monitoring studies conducted between April and November at the 195-turbine Maple Ridge Wind Project in New York in 2007 and the 44-turbine Mountaineer Wind Project in West Virginia in 2003 estimated 15.54 to 18.53 bat fatalities/turbine/year (Jain et al. 2008) and 47.53 bat fatalities/turbine/year (Kerns and Kerlinger 2004), respectively. At Maple Ridge, 64 turbines were searched weekly, and at Mountaineer, 44 turbines were searched twice per week. In comparison, bat fatality estimates in Maine range from 0.18 bats/turbine/yr (at the Rollins Wind Project in 2012; Stantec Consulting 2012b) to 6.78 bats/turbine/yr (at the Record Hill Wind Project in 2012; Stantec 2012 c) (Appendix B Table 2). The Rollins Wind Project has 40 turbines, 20 of which (50%) were searched weekly between April 15 to October 15. The Record Hill Wind Project has 22 turbines, all of which were searched 3 times every 2 weeks from April 15 to June 7 and July 7 to October 15. Mortality estimates at the Maine projects used estimator adjustment calculations derived from searcher efficiency and scavenger trail data, which has been standard protocol for post-construction monitoring in Maine. However, differences among studies (between projects within Maine, and between Maine studies and studies in other states) such as survey period, search interval, number of turbines searched, size of search area, non-searchable area corrections, visibility within search plots, and overall study objectives must be considered when making any direct comparisons between studies.

Despite what is currently known about bat collision rates in Maine, it is important to acknowledge that little is known about the migration routes and the numbers of migratory bats in Maine and other states and the factors contributing to levels of risk. Pre- and post-construction acoustic surveys at wind facilities have documented bat activity to be positively correlated with nightly mean temperatures and negatively correlated with wind speed (Fiedler 2004, Reynolds 2006). Reynolds (2006) found that no detectable spring migratory activity occurred on nights when the mean temperature was below 10.5°C (50.9°F). Bat activity at Buffalo Mountain, West Virginia from 2000 to 2003 was most closely correlated with average nightly temperature (Fiedler 2004). Although some activity at Bingham did occur on cold nights, peak activity occurred on nights with temperatures above 10°C. Reynolds (2006) found activity of bats to be highest on nights with wind speeds of < 5.4 meters per second (m/s) during the spring migratory period at the Maple Ridge, New York wind facility. Bat activity levels at Buffalo Mountain, Tennessee also showed a negative association with average nightly wind speeds (Fiedler 2004). At Bingham, peak activity occurred on a night when mean wind speeds were 5.8 m/s.

Researchers currently have a limited understanding of the actual mechanism of bat collisions, although evidence from the timing of fatalities documented at existing wind facilities and other structures suggests that migrating bats are most at risk, whereas resident bats during the summer feeding and pup-rearing period are considered low risk (Johnson and Strickland 2004, Johnson et al. 2003, Whitaker and Hamilton 1998). Additionally, only certain species of bats appear to be at risk. Of the 45 species of bats that occur in the U.S., only approximately 12 species have been found during mortality searches (Arnett et al. 2008, West 2011). In most regions including the eastern U.S., migratory tree-roosting species such as hoary, eastern red, and silver-haired bats have higher mortality rates at wind projects than cave-dwelling species (Arnett et al. 2008). See Table 5 for the percent of total fatalities and number of migratory tree-roosting bats found during standard surveys[5] at operational projects in Maine.

[5] Standard surveys at Mars Hill included dog searches.

Table 5. Migratory tree-roosting bat fatalities at operational projects in Maine.

Project	Year	Percent (Number) of migratory tree-roosting bats	Source
Mars Hill	2007	71% (17)	Stantec Consulting 2008
Mars Hill	2008	100% (5)	Stantec Consulting 2009
Stetson I	2009	60% (3)	Stantec Consulting 2010
Stetson I	2011	100% (4)	Normandeau Associates 2010a
Stetson II	2010	79% (11)	Normandeau Associates 2010b
Stetson II	2012	100% (4)	Stantec Consulting 2012a
Rollins	2012	50% (1)	Stantec Consulting 2012b
Kibby	2011	78% (7)	Stantec Consulting 2011
Record Hill	2012	100% (44)	Stantec Consulting 2012c

5.2.3. Summary of Collision Risk at the Bingham Wind Project

Impacts to birds and bats due to the project are expected to be comparable to other projects located on forested ridgelines in the Northeast U.S. Other projects on forested ridgelines in the region share similar landscape features, as well as similar land use activities to the project (i.e., timber harvest). The proposed project will include a similar post-construction mortality monitoring study to those conducted at other projects recently in the region. However, the Curtailment Plan (Exhibit 7E-1) indicates that curtailment at half of the turbines would be incorporated into the post-construction monitoring protocol of the proposed project. Only one curtailment study has been conducted in the Northeast U.S. to-date (Sheffield, Vermont in 2012); therefore, with curtailment treatments to reduce bat fatalities, bat mortality at the proposed project would be expected to be lower than that reported at other projects in the region that have not incorporated curtailment into their study plans. Curtailment has been shown to be an effective strategy to reduce bat mortality. One recent study in Pennsylvania documented reductions in nightly fatality from 44 to 93 percent (Arnett et al. 2010).

Results of pre-construction surveys alone cannot predict level of risk at a project. These survey results when compared to similar projects in the region can illustrate regional patterns in migration activity, timing, or species composition (in the case of raptors). Understanding regional patterns may help illustrate the potential level of risk at a project. The results of site-specific pre-construction surveys conducted for this project are consistent with the results of surveys conducted at other wind projects in the East and Northeastern U.S., as summarized below and further described in the seasonal Avian and Bat Migration Survey Reports (Exhibit 7D).

Raptors

The results of raptor surveys conducted for this project are typical, and within the range of results documented at other proposed wind projects in the region. In fall 2010, 11 raptor species were documented during migration surveys conducted from two locations, Kingsbury Ridge and Johnson Ridge. Species observed were those expected to occur in this region of the Northeast during migration. The range in number of species observed in fall at other projects in the East and Northeast is 0 species (at multiple sites) to 15 species (at a project in Clinton County, New York). No state or federally-listed raptor species were observed during surveys conducted for this project. Two state species of Special Concern were observed: bald eagle (n=6) and northern harrier (n=3). Of these observations, 3 bald eagle observations (50%) and no northern harrier observations (0%) occurred within the project area. The seasonal passage rate at Kingsbury Ridge was 0.68 raptor observations per hour and at Johnson Ridge, it was 1.74 observations per hour. When compared to fall passage rates at other projects located on forested ridgelines in the East and Northeast, these passage rates are relatively low (0 raptor observations per hour at multiple sites to 12.7 raptor observations per hour at a project in Bennington County, Vermont) (Stantec unpub.). At Johnson Ridge, 34 percent of observations occurred in the project area and of those, 100 percent occurred below the proposed maximum turbine height. At Kingsbury Ridge, 23 percent of observations occurred in the project area, and of those, 85 percent occurred below turbine height. Percent below turbine height at Kingsbury Ridge falls within the range of fall results at other projects in the East and Northeast, and results at Johnson Ridge occur just at the high end of the range of results (43% at a project in Grafton County, New Hampshire to 98% at the Bull Hill wind project in Hancock County, Maine).

In spring 2010, nine raptor species were observed. Species observed were those expected to occur in this region of the Northeast during migration. Spring 2011 surveys at other projects in the East and Northeast documented 6 (at multiple sites) to 12 species (at multiple sites). No state or federally-listed raptor species were observed. One state-listed species of Special Concern was observed: bald eagle (n=6). Of these 6 observations, 4 (67%) occurred in the project area. The seasonal passage rate at Kingsbury Ridge was 0.27 raptor observations per hour and at Johnson Ridge was 1.06 observations per hour. These passage rates are at the low end of the range of spring passage rates at other projects on forested ridges in the East and Northeast (0.21 raptor observations per hour at a project in Coos County, New Hampshire to 15.4 raptor observations per hour at a project in Jefferson County, New York) (Stantec unpub.). At Johnson Ridge, 57 percent of observations occurred in the project area and of those, 95 percent occurred below the proposed maximum turbine height. At Kingsbury Ridge, 68 percent of observations occurred in the project area, and of those, 77 percent occurred below turbine height. Percent below turbine height at both ridges in the project fall within the range of spring results at other projects in the East and Northeast (25% at a project in Grafton County, New Hampshire to 100% at the Bull Hill wind project in Hancock County, Maine).

Pre-construction raptor survey results have not shown a correlation to post-construction mortality of raptors. The risk of raptor collision at facilities other than those located at migration bottlenecks or high use areas is relatively low. Because most raptors are diurnal and modern turbines have comparatively slower spinning blades, raptors can avoid the spinning turbine blades and rotor structures. The turbines at the project will consist of this modern design, lacking the features believed to present a greater risk of collision. Additionally, most raptors migrate during periods of good visibility when conditions are favorable for long-distance flight. Therefore, the risk of migrant raptors colliding with the proposed turbines is anticipated to be low. Some resident raptors engage in flight behaviors that could put them at a greater risk of collision, such as aerial courtship displays. Owls primarily forage during nocturnal and crepuscular periods. Despite these behaviors, mortality surveys at existing wind developments, outside of the California, have documented low raptor mortality. Although one raptor fatality, a barred owl (*Strix varia*), was documented in two years of study (2007 and 2008) at Mars Hill, it was thought to have possibly been a natural kill resulting from the severe 2007-2008 winter (Stantec Consulting 2008).

At Stetson I, post-construction raptor surveys occurred in conjunction with the post-construction mortality surveys. A total of 79 raptors (34 in spring; 45 in fall) were observed during 70 hours of survey during both spring and fall survey seasons (Stantec 2010). Two red-tailed hawks were found during the concurrent post-construction mortality surveys; however both mortalities resulted from contact with a riser pole of the electrical collection system that resulted in electrocution of the birds and not from collision with a turbine. Incidental observations of raptors during the mortality survey at Stetson I in 2009 included instances of raptor turbine-avoidance behaviors. Out of 47 incidental observations, 7 raptors exhibited turbine-avoidance behaviors. For these seven observations, raptors made slight changes to their flight paths as they approached spinning turbines. No raptors observed came into contact with the turbines, and no raptor fatalities were documented under turbines despite continued use of the airspace during migration or breeding periods (Stantec 2010). Raptor mortality data from other projects in the U.S. and from Stetson I and Stetson II indicated that this trend of low raptor mortality can also be expected at the project.

To the extent practicable, the project has been designed to reduce potential detrimental effects to local wildlife, including raptors. For example, all but approximately 1.7 miles of the electrical collector system will be installed underground within project roadways. The aboveground portion of the electrical collector system has been designed with consideration of the Avian Power Line Interaction Committee's (APLIC) Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006 (APLIC 2006). This manual was developed to mitigate and avoid electrocution with overhead electrical lines. The overall goal of the collection system design is, to the extent practicable, reduce risk of avian electrocution while ensuring maintaining the reliability safety of the system.

Nocturnal Migrants

In terms of timing and flight height, the results of radar surveys conducted at the project are consistent with results documented at other proposed wind projects in the region (Exhibit 7D). The seasonal spring passage rate (543 ± 30 targets per kilometer per hour [t/km/hr]) was within the range of spring passage rates at other projects on forested ridges in the East (147 t/km/hr at Stetson I in Washington County, ME to 1020 t/km/hr at a project in Grant City, West Virginia). The percent below turbine height in spring (21%) is within the range of spring results from other projects in the East (3% at a project in Barbour County, West Virginia to 38% at the Bull Hill Project in Hancock County, Maine).

In fall 2010 and fall 2011, passage rates at the project (803 ± 46 and 952 ± 63) were at the high end of the range compared to other projects in the East (91 t/km/hr at a project in Caledonia County, Vermont to 811 t/km/hr at a project in Grant County, West Virginia). However, the percent below turbine height in both fall seasons (20% and 16%) is within the range of fall results from other projects in the East (1% at multiple projects to 40% at a project in Hillsborough, New Hampshire).

The results of these and other radar studies conducted in the eastern U.S. suggest that the vast majority of nocturnal migrants fly at altitudes well above the rotor swept zone of proposed turbines. Flight heights documented during radar surveys in the project area, as well as emerging evidence from other studies indicate that flight height is more important in determining potential collision risk than factors such as passage rate or flight direction. Based upon flight height documented at the project, there appears to be limited collision risk for nocturnal migrants. There has been no documented population-level impact to an individual songbird species from a wind development project. A recent summary of avian mortality at communication towers suggests that, for 177 bird species for which collision and population trend data is available, there is no correlation between collision vulnerability and annual rate of population change indicating that this source of mortality has no observable effect on these populations (Arnold and Zink 2011). In fact, many of the species involved in collisions with manmade structures have increasing population trends (Arnold and Zink 2011), suggesting that collisions involve regionally abundant species. Also, mortality of avian species at manmade structures, including wind turbines, has involved a diverse assemblage of species rather than disproportionate impacts to a single species (Environmental Bioindicators Foundation, Inc. and Pandion Systems, Inc. 2009).

Another example of a strategy to reduce impacts to wildlife and particularly to songbirds involves minimizing lighting on the turbines and on buildings within the project area. Because nocturnal migrants, particularly songbirds, are attracted to steady burning lights, which can lead to fatalities principally through collisions with structures, lighting for the project will be minimized to the extent practicable to maintain safe operations (Longcore et al. in press 2011). The project also has been designed to use the existing road network where possible and to minimize construction of new roads, which should reduce habitat loss/conversion and species displacement. Wetland areas will be avoided to the maximum extent practicable to reduce impacts to species that use these habitats, including migratory waterbirds and waterfowl.

Breeding Birds

No state or federally-listed bird species were detected during the spring and summer 2010 breeding bird surveys conducted at the project. During the breeding bird surveys, a total of 787 individual birds representing 50 species were identified within the project area. These totals included nine state-listed species of Special Concern. Because songbirds on their breeding grounds tend to be active during the day and migration generally occurs at night, collision risk with turbines tends to be lower for breeding birds than for migrating individuals. Impacts to breeding birds at wind projects more often occur during project construction as the result of displacement or disturbance rather than from direct mortality. As no state or federally-listed breeding bird species were detected during onsite breeding bird surveys, impacts to these species are not expected.

Bats

The acoustic bat surveys conducted at the project documented results similar to other pre-construction surveys. The results of these surveys, including variability in bat activity and generally low detection rates above canopy height, are consistent with other publicly available acoustic surveys conducted at proposed wind projects in the region (Exhibit 7D). Although bats are present in the project area, the activity levels and guilds detected are similar to those documented at other sites including Mars Hill, Stetson, and Lempster (Exhibit 7D).

At this project, no bats belonging to the red bat/tri-colored bat guild (both tree-roosting bats) were recorded by met tower detectors in spring 2010, and no bats from this guild were recorded by the Bessey met tower detectors in summer and fall 2010. Mortality of migratory tree-roosting bats at this project may therefore be lower than at other projects in the Northeast (Table 5).

In addition, the Applicant has committed to curtail wind turbines during wind conditions when previous studies have shown that bats are active, and when existing Maine-based post-construction fatality data indicates that the potential for bat mortality is greatest.

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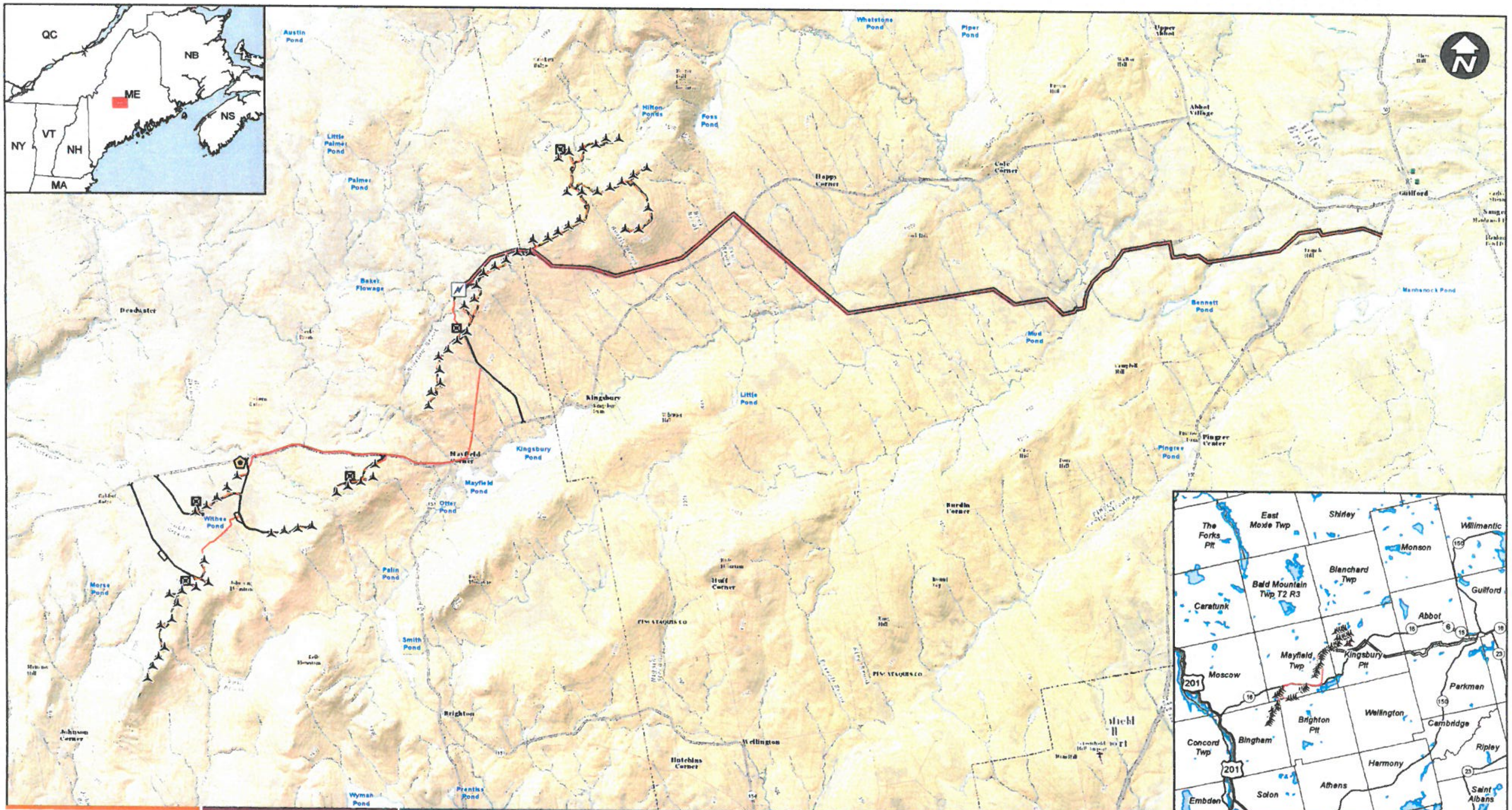
FIGURE 1



Stantec Consulting Services Inc.
30 Park Drive
Topsham, ME USA
04086
Phone (207) 729-1199
Fax: (207) 729-2715
www.stantec.com

Stantec

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Legend

- Turbine Location
- Permanent MET Tower
- O&M Building
- Substation
- Edge of Gravel
- Electrical Generator Lead
- Overhead Collector
- Underground Collector

0 8,000
Feet

Client/Project
Bingham Wind Project

195600539

Figure No.
1

Title
Bingham Wind Project Location
4/16/2013

Appendix A
Wildlife Observations and Wildlife Habitat Use Matrix

Common Name	Scientific Name	Special Habitat Requirements	Likely Relative Abundance in the State	Maine	Federal	Beech-Birch-Maple-Forest	Harvested Hardwood Forest	Softwood Plantations	Forested Wetlands	Forested Streams	Vernal Pools	Observed During Surveys	Observed Incidentally to Surveys	Migration Only
Amphibians														
Blue-spotted salamander	*Ambystoma laterale*	Wooded swamps, ponds or vernal pools for breeding	U	SC		Y			Y	B	B	X		
Bullfrog	*Rana catesbeiana*	Deep permanent water and emergent vegetation	C							Y	Y	X	X	
Dusky salamander	*Desmognathus fuscus*	Permanent or intermittent streams or seeps in woodlands	C			Y			Y	Y			X	
Gray treefrog	*Hyla versicolor*	Aquatic sites	U			Y	Y		B		B		X	
Green frog	*Rana clamitans*	Riparian areas, wooded swamps, ponds and vernal pools	A						Y	Y	Y	X	X	
Northern redback salamander	*Plethodon cinereus*	Wide variety of terrestrial habitats, mostly forested	C			Y				Y				
Northern two-lined salamander	*Eurycea bislineata*	Wide variety of habitats, including streams, floodplains, and swamps	C			Y				Y			X	
Northern spring salamander	*Gyrinophilus porphyriticus*	Cold streams, seeps, or springs with flat rocks or crevices	C	SC						Y		X		
Spotted salamander	*Ambystoma maculatum*	Mesic woods, semi-permanent water for breeding	U			Y	Y		B	B	B	X		
Wood frog	*Lithobates sylvaticus*	Vernal pools in woodland setting	A			Y			Y	B	B	X		
Reptiles														
Eastern garter snake	*Thamnophis sirtalis*	Ubiquitous; moist areas	A			Y	Y		Y		Y		X	
Northern redbelly snake	*Storeria occipitomaculata*	Woodland debris: bark or rotting wood	C			Y	Y		Y			X		
Wood turtle	*Clemmys insculpta*	Wooded banks of sandy-bottom streams with adjacent meadows	U	SC						Y			X	
Birds														
Alder flycatcher	*Empidonax alnorum*	Wet areas with dense, low shrubs or clearings with wet edges	C				B	B	B	B	B	X	X	
American crow	*Corvus brachyrhynchos*	Open areas for foraging	A			Y	Y	Y	Y	Y	Y	X	X	
American goldfinch	*Carduelis tristis*	Spruce and fir forest	A			Y	Y	Y	Y	Y	Y	X	X	
American kestrel	*Falco sparverius*	Open flat areas, cavity trees	C				B	B				X		
American redstart	*Setophaga ruticilla*	Early successional deciduous habitats	C	SC		B	B					X	X	
American robin	*Turdus migratorius*	Lawns, fields, agricultural areas, forest openings	A			B	B	B				X		
American woodcock	*Scolopax minor*	Fields or forest openings for courtship; brushy swales for cover; reverting farms	C				B		B	B	B		X	
Bald eagle	*Haliaeetus leucocephalus*	Large bodies of fish supporting water, large supercanopy trees for nesting	U	SC								X	X	X
Barred owl	*Strix varia*	Cool, damp lowlands, cavity trees >20" dbh	C			Y	Y		Y	Y	Y		X	
Bay-breasted warbler	*Dendroica castanea*	Second-growth boreal forests	C					B	B	B	B	X		
Belted kingfisher	*Megaceryle alcyon*	Near water, sandy sites with steep banks	C						B	B	B		X	
Black-and-white warbler	*Mniotilta varia*	Deciduous or mixed conifer-hardwood forests	C	SC		B	B		B			X	X	
Blackburnian warbler	*Dendroica fusca*	Coniferous forests, mixed woodlands	C				B	B	B			X		
Black-capped chickadee	*Poecile atricapilla*	Cavity trees >4" dbh	A			Y	Y	Y	Y	Y	Y	X	X	
Blue-headed vireo	*Vireo solitarius*	Low, shrubby vegetation or brambles	C				B	B	B	B	B	X		
Black-throated blue warbler	*Dendroica fusca*	Hardwoods with well-developed understory	C			B	B		B	B	B	X		
Black-throated green warbler	*Dendroica virens*	Coniferous forests, mixed woodlands	C			B	B		B			X		
Blue jay	*Cyanocitta cristata*	Variety of rural to urban habitats	A			Y	Y	Y	Y	Y	Y	X		
Broad-winged hawk	*Buteo platypterus*	Extensive woodlands with roads or clearings	C			B	B		B		B	X		
Brown creeper	*Certhia americana*	Standing dead trees with loose bark	C			B	B	B	B			X		
Brown-headed cowbird	*Molothrus ater*	Open fields, actively grazed pastures, mowed grassy areas	C				B	B					X	
Canada goose	*Branta canadensis*	Elevated sites in marshes for nesting	C										X	X
Canada warbler	*Dendroica tigrina*	Forest with dense understory, along streams, bogs, or swamps	C	SC		B	B		B			X	X	
Cedar waxwing	*Bombycilla cedrorum*	Wide variety of habitats. Berry- or fruit-producing trees and shrubs, forest edges and riparian areas	C			B	B		B	B	B	X		
Chestnut-sided warbler	*Dendroica pensylvanica*	Early second growth deciduous stands, regenerating clearcuts or shelterwood cuts with dense vegetation	C	SC		B	B					X		

Common Name	Scientific Name	Special Habitat Requirements	Likely Relative Abundance in the State	Maine	Federal	Beech-Birch-Maple-Forest	Harvested Hardwood Forest	Softwood Plantations	Forested Wetlands	Forested Streams	Vernal Pools	Observed During Surveys	Observed Incidentally to Surveys	Migration Only
Chimney swift	*Chaetura pelagica*	Chimneys and dead hollow large trees in wetlands	C	S C					B					
Chipping sparrow	*Spizella passerina*	Suburban residential areas, farms, orchards, clearings in forests, borders of lakes and streams	C				B		B	B			X	
Common grackle	*Quiscalus quiscala*	Wetlands, open areas and scrub shrub wetlands	A			B	B		B					
Common raven	*Corvus corax*	Cliffs and outcrops in rural areas	C			Y	Y		Y				X	
Common yellowthroat	*Geothlypis trichas*	Moist Shrublands, dense forest edges, regenerating fields and forests	C			B	B		B	B		X	X	
Cooper's hawk	*Accipiter cooperii*	Mature forests in open country, urban woodlots, tolerates forest fragmentationa and human distrubance	C			B		B	B					
Dark-eyed junco	*Junco hyemalis*	Edges and small openings in coniferous and mixed forests, logging roads, and old burns	C				B	B	B			X	X	
Double-creasted cormorant	*Phalacrocorax auritus*	coastal bays, estuaries, marine islands, freshwater lakes, ponds, and rivers	A										X	X
Downy woodpecker	*Picoides pubescens*	Trees, limbs with decay column >6" dbh	C			Y	Y		Y				X	
Eastern phoebe	*Sayornis phoebe*	Exposed, streamside perches, sheltered ledges for nesting	C			B	B		B	B				
Eastern wood-pewee	*Contopus virens*	Open deciduous and mixed forests, forest edge	C	S C		B	B					X		
Hairy woodpecker	*Picoides villosus*	Trees, limbs with decay column >10" dbh	C			Y	Y		Y			X	X	
Hermit thrush	*Catharus guttatus*	Coniferous woodlands with dense understory	C			B						X	X	
House wren	*Troglodytes aedon*	Thickets and cavities for nesting	U						B				X	
Golden-crowned kinglet	*Regulus satrapa*	Conifer and mixed conifer-hardwood forests	C				Y	Y	Y			X	X	
Great-crested flycatcher	*Myiarchus crinitus*	Natural tree cavities in deciduous forest edge	C			B						X		
Least flycatcher	*Empidonax minimus*	Open mature and second-growth hardwood and mixed forest	C	S C		B			B			X		
Magnolia warbler	*Dendroica magnolia*	Young fir or spruce stands	C				B		B			X	X	
Mallard	*Anas platyrhynchos*	Shallow water for feeding	A						B					
Merlin	*Falco columbarius*	Open forests adjacent to open areas	U									X		X
Mourning dove	*Zenaida macroura*	Open land with bare ground	C				Y						X	
Mourning warbler	*Oporornis philadelphia*	Stands of dense saplings and shrubs, disturbed second growth	U			B	B					X		
Nashville warbler	*Vermivora ruficapilla*	Disturbed second growth; scattered trees interspersed with brush	C			B	B		B			X	X	
Northern flicker	*Colaptes auratus*	Open areas, trees with heart rot	C			B	B		B			X	X	
Northern harrier	*Circus cyaneus*	Open areas or wetlands with low vegetation	U	S C					B			X		
Northern mockingbird	*Mimus polyglottos*	Low, dense woody vegetation	C										X	
Northern parula	*Parula americana*	In lichen *Usnea* in moist forests	C						B	B		X		
Northern waterthrush	*Seiurus noveboracensis*	Cool, shady, wet brushy areas with open pools of water	U						B			X		
Olive-sided flycatcher	*Contopus cooperi*	Tall perches near exposed wetland areas	C	S C				B	B				X	
Osprey	*Pandion haliaetus*	Elevated nesting areas near a body of water	C						B			X		
Ovenbird	*Seiurus aurocapillus*	Deciduous or mixed conifer-hardwood forests	C			B	B					X	X	
Peregrine falcon	*Falco peregrinus*	Cliffs and outcrops	U	S C*								X		X
Pileated woodpecker	*Dryocopus pileatus*	Mature trees >20" dbh with decay	C			Y	Y					X	X	
Pine warbler	*Dendroica pinus*	Pine stands	U					B						
Purple finch	*Carpodacus purpureus*	Coniferous trees	C					B				X	X	
Red-breasted nuthatch	*Sitta canadensis*	Cavity trees in mixed or coniferous woods	C				Y	Y	Y					
Red-eyed vireo	*Vireo olivaceus*	Deciduous forests with continuous canopy	C			B	B		B			X	X	
Red-tailed hawk	*Buteo jamaicensis*	Mature forest-field ecotone	C			Y	Y		Y			X		
Rose-breasted grosbeak	*Pheucticus ludovicianus*	Forest-field ecotones, thickets, sapling stands	C			B	B		B	B		X		
Ruby-crowned kinglet	*Regulus calendula*	Coniferous forests in pure or mixed stands of spruce, tamerack, or pine	C					B	B				X	
Ruby-throated hummingbird	*Archilochus colubris*	Tubular flowers, especially red	C			B	B			B			X	

Common Name	Scientific Name	Special Habitat Requirements	Likely Relative Abundance in the State	Maine	Federal	Beech-Birch-Maple-Forest	Harvested Hardwood Forest	Softwood Plantations	Forested Wetlands	Forested Streams	Vernal Pools	Observed During Surveys	Observed Incidentally to Surveys	Migration Only
Ruffed grouse	*Bonasa umbellus*	Fallen logs amidst dense saplings	C			Y	Y		Y	Y		X	X	
Scarlet tanager	*Piranga olivacea*	Mature deciduous and mixed conifer-hardwood forests	C			B	B		B					
Sharp-shinned hawk	*Accipiter striatus*	Extensive, undisturbed open mixed woodlands	U						Y			X		
Snow bunting	*Plectrophenax nivalis*	Open areas	C				W							
Song sparrow	*Melospiza melodia*	Moist areas with brushy vegetation	C				B		B			X	X	
Spruce grouse	*Falcipennis canadensis*	Large stands of dense coniferous forest	U					Y					X	
Swainson's thrush	*Catharus ustulatus*	Coniferous or mixed forest adjacent to water, low damp areas	U				B		B			X	X	
Turkey vulture	*Cathartes aura*	Forest openings, fields, large dead tree trunks	C									X		X
Veery	*Catharus fuscescens*	Moist woodlands with understory	C	SC			B		B					
White-breasted nuthatch	*Sitta carolinensis*	Cavity trees in hardwoods or mixed woods	C			Y	Y					X		
White-throated sparrow	*Zonotrichia albicollis*	Shrublands and dense forest edges	C	SC		B	B	B	B			X	X	
White-winged crossbill	*Loxia leucoptera*	Cone-bearing mature coniferous forests	U					Y					X	
Wild turkey	*Meleagris gallopavo*	Forests with mast-producing trees, openings, and dense vegetation for roosting	C			Y	Y						X	
Winter wren	*Troglodytes troglodytes*	Conifer forests near water, often in ravines and swamps	C				B	B	B			X	X	
Yellow warbler	*Dendroica petechia*	Dense deciduous thickets with few taller trees	C	SC						B		X		
Yellow-bellied flycatcher	*Empidonax flaviventris*	Low, wet areas with coniferous forest	C						B			X		
Yellow-bellied sapsucker	*Sphyrapicus varius*	Dead or live trees with a central decay column	C			B						X	X	
Yellow-rumped warbler	*Dendroica coronata*	Coniferous trees, bayberry thickets	C				B		B			X	X	
Mammals														
American marten	*Martes americana*	Variety of forests with den sites in large hollow trees or logs	U				Y						X	
Beaver	*Castor canadensis*	Streams with an abundance of young hardwood	C						Y	Y			X	
Big brown bat	*Eptesicus fuscus*	Cold dry cave in winter	C			R	R		R	R		X		
Black bear	*Ursus americanus*	Fallen trees, hollow logs, rock ledges, slash piles, northern hardwoods, mixed forests	C			Y	Y		Y	Y			X	
Bobcat	*Lynx rufus*	Dense hardwood or softwood understories with high hare densities	U					Y				X		
Bog lemming**	*Synaptomys sp.*	Moist soils with leaf mold	U							Y		X		
Canada lynx	*Lynx canadensis*	Dense fir forest with high hare densities	R		T		W	W				X		
Coyote	*Canis latrans*	Forests, forest edges, agricultural land	U			Y	Y		Y	Y		X		
Deer mouse	*Peromyscus maniculatus*	Down logs, rotting stumps in coniferous and mixed forests	C				Y							
Eastern chipmunk	*Tamias striatus*	Forests with brushy areas	C			Y	Y	Y	Y	Y			X	
Eastern red bat	*Lasiurus borealis*	Deciduous trees on forest edges for roosting	U	SC		R	R		R	R				
Eastern tri-colored bat	*Perimyotis subflavus*	Warm, draft-free, damp sites for hibernation, open woodlands	U	SC		R	R		R	R				
Ermine	*Mustela erminea*	Dense brushy cover with high densities of small mammal prey	C				Y		Y	Y		X		
Fisher	*Martes pennanti*	Coniferous or mixed forest with dens in hollow trees, logs, or holes under boulders	C						Y			X		
Hoary Bat	*Lasiurus cinereus*	Edges of coniferous forests	U	SC		R	R		R	R				
Moose	*Alces alces*	Wetlands preferred in the summer for insect relief and aquatic vegetation	C			Y	Y		Y	Y		X		
Little brown bat	*Myotis sp.*	Dark, warm sites for maternity colonies	C	SC		R	R		R	R				
Masked shrew	*Sorex cinereus*	Damp deciduous and coniferous woodlands with leaves and rotting logs for cover	U				Y	Y	Y					
Northern flying squirrel	*Glaucomys sabrinus*	Conifers in summer, hollow trees and cavities in winter	U			Y	Y	Y						
Northern short-tailed shrew	*Blarina brevicauda*	Forested areas with low vegetation, loose leaf litter and high humidity	C			Y	Y							
Porcupine	*Erethizon dorsatum*	Mixed or coniferous forest with den sites in rock ledges or trees	C				Y						X	
Pygmy shrew	*Sorex hoyi*	Wide variety of forests with moist leafmold near water	U			Y			Y					
Red fox	*Vulpes vulpes*	Variety of habitats in suitable den sites	C			Y	Y		Y	Y		X		

Common Name	Scientific Name	Special Habitat Requirements	Likely Relative Abundance in the State	Maine	Federal	Beech-Birch-Maple-Forest	Harvested Hardwood Forest	Softwood Plantations	Forested Wetlands	Forested Streams	Vernal Pools	Observed During Surveys	Observed Incidentally to Surveys	Migration Only
Red squirrel	*Tamiasciurus hudsonicus*	Woodlands with mature trees	C				Y		Y			X		
River otter	*Lutra canadensis*	Water body, river, or stream with fish, dens, and riparian vegetation	U						Y	Y			X	
Silver-haired bat	*Lasionycteris noctivagans*	Dead trees with loose bark; streams	U	SC		R	R		R	R				
Snowshoe hare	*Lepus americanus*	Dense brushy or softwood cover	C			Y	Y	Y	Y	Y		X		
Southern red-backed vole	*Clethrionomys gapperi*	Cool, moist, deciduous or mixed forest near water sources	C						Y	Y				
White-tailed deer	*Odocoileus virginianus*	Softwood yarding cover in winter	C			Y	Y		Y	Y			X	
Woodland jumping mouse	*Napaeozapus insignis*	Moist, cool woodland, loose soils	U				Y		Y	Y				

*breeding population, only
**northern bog lemming (*Synaptomys borealis*) is state T

Relative Abundance
A – Abundant
C – Common
U – Uncommon
R – Rate

Status
E – Endangered
T – Threatened
SC – Special Concern

Season of Use
B – Breeding
R – Roosting (for bats)
W – Wintering
Y – Year round

Appendix B
Publicly Available Post-Construction Results

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
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.
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.
Mountaineer, West Virginia	forested ridgeline (44)	April 4 - Nov 11, 2003	2x per week	475	47.53 (2092)	69*	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.
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.
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.
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.
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.
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.
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.
Casselman, Somerset Cty, PA	forested ridge, grassland mine ridge (23)	July 27 - October 9, 2008	22 daily	32***	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***	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.
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.
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.

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
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.
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.
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.
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 1: 5.04 (252); weekly 2: 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.
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.
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.
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.
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.
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.
Rollins, Maine	forested ridgeline (40)	April 15 to October 15, 2012	20 weekly	2 (0)	0.18 (7.2)****	9 (7)	2.94 (118)***	Stantec Consulting. 2012. RollinsWind Project Post-Construction Monitoring Report, 2012. Prepared for First Wind, LLC.
Stetson II, Maine	forested ridgeline (17)	April 15 to October 15, 2012	17 weekly	4 (0)	2.06 (36)****	5 (0)	2.83 (49)***	Stantec Consulting. 2012. Stetson II Wind Project Post-Construction Monitoring Report, 2012. Prepared for First Wind, 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)****	46 (7)	8.46 (187)****	Stantec Consulting. 2012. Record Hill Wind Project Post-Construction Monitoring Report, 2012. Prepared for Record Hill Wind, LLC.

*33 birds found on May 23, 2003 at turbines near a substation and at substation associated with sodium vapor lights
**Results of spring interim report, study period April 20 to June 1.
***Fresh bats found at curtailment treatment turbines reported only.
****Based on the Huso fatality estimator with area corrections.

Exhibit 7C-3: Eagle Survey Summary Report

Memo

To:	Josh Bagnato and Bob Roy First Wind	From:	Bryan Emerson Stantec Consulting
File:	195600539	Date:	March 27, 2013

Reference: **Aerial Bald Eagle Nest Survey Summary**
Proposed Bingham Wind Project

Stantec Consulting (Stantec) has completed three years of aerial surveys for bald eagle (*Haliaeetus leucocephalus*) nests in the vicinity of the proposed Bingham Wind Project (project). The proposed project consists of 62 turbines located in Bingham, Kingsbury, and Mayfield, Maine. The proposed turbines are located on several small ridges and hills in the vicinity of Route 16, including Johnson Mountain and unnamed hills north and northeast of Johnson Mountain, and an unnamed ridge north of Route 16 (Figure 1).

This memo summarizes the results of the aerial surveys conducted by Stantec in 2009, 2010, and 2011, along with bald eagle nest data obtained from the Maine Department of Inland Fisheries and Wildlife (MDIFW) for 2012. Stantec's aerial surveys included inspections of known nest locations and searches of waterbodies within 10 miles or less of the proposed project area. Prior to the surveys, Stantec reviewed information provided by MDIFW regarding known active and historic bald eagle nest locations in the vicinity of the Project area. Following protocol previously established by the U.S. Fish and Wildlife Service (USFWS),[1] Stantec notified Mark McCullough of the USFWS Maine Field Office that flights were planned in this area and that Stantec was coordinating with MDIFW on the timing and methods of the flights. During the aerial surveys conducted by Stantec, incidental observations of osprey (*Pandion haliaetus*) nests and great blue heron (*Ardea herodias*) rookeries were also recorded.

In October 2009, Stantec conducted the aerial survey in accordance with the 2007 National Bald Eagle Management Guidelines. Based on consultation with MDIFW and USFWS, a 5-mile radius from the potential project area was chosen for this survey. In November 2009, the Maine Field Office of USFWS issued the Guidelines for Building and Operating Wind Energy Facilities in Maine Compatible with Federal Fish and Wildlife Regulations.[2] In this document, a four mile radius from a proposed project was recommended as the distance to survey to identify eagle nesting areas. This document was released after Stantec's fall 2009 aerial survey; however, Stantec's 2010 spring survey was conducted according to these 2009 guidelines. In January 2011, USFWS issued the Draft Eagle Conservation Plan Guidance[3] to assist parties in avoiding and minimizing adverse effects on bald eagles. In this document, USFWS recommends that surveys to determine the locations of occupied bald eagle nests should be conducted within the project footprint and within 10 miles of the footprint. Stantec's survey protocol in 2011 was adjusted to adhere to this recommendation.

[1] U.S. Fish and Wildlife Service, 2007. *National Bald Eagle Management Guidelines*. U.S. Fish and Wildlife Service, Washington, DC.
[2] U.S. Fish and Wildlife Service. 2009. *Guidelines for Building and Operating Wind Energy Facilities in Maine Compatible with Federal Fish and Wildlife Regulations*. Maine Field Office, U.S. Fish and Wildlife Service, Orono, ME.
[3] U.S. Fish and Wildlife Service, 2011. *Draft Eagle Conservation Plan Guidance*. U.S. Fish and Wildlife Service, Washington, DC.

Survey Methods

Stantec conducted aerial surveys during three separate years in 2009, 2010, and 2011. MDIFW provided data from aerial surveys performed in 2012. Each aerial survey conducted by Stantec consisted of low altitude passes in a Cessna 172 aircraft, approximately 500 feet above ground level, along the shoreline of waterbodies within the survey area. Based on consultation with MDIFW, the aerial surveys were conducted in accordance with MDIFW and USFWS aerial survey protocols regarding methods and approximate time of year for surveys.

In 2009, Stantec performed a fall survey for bald eagle nests within an approximately 5-mile radius of the proposed turbine locations for the project, in accordance with existing protocol at the time. Note that this survey was performed outside of the breeding period for bald eagles; therefore, information regarding breeding activity at any nests was not recorded. The survey was performed in order to identify possible active nest locations that would require a monitoring visit during the spring 2010 breeding period.

In 2010, Stantec conducted the first aerial survey flight of the year on May 12. The purpose of the flight was to identify new nests and to assess eagle nesting activity at known nest locations. In 2010, the survey was performed within 4 miles of the project area, consistent with protocol described in the 2009 Guidelines for Building and Operating Wind Energy Facilities in Maine. The timing of the first flight was chosen in consultation with MDIFW to correspond with the time period when bald eagles are actively incubating eggs. The second flight was conducted on June 18, 2010, to check the status of active nests in the project area and to perform a second search on areas where a nest was suspected but not seen during the first flight. The timing of the second flight was chosen to correspond to the time period when eaglets have hatched and are visible in the nest to determine hatching success.

In 2011, Stantec conducted the first aerial survey flight on May 2. Stantec performed the survey using a 10-mile radius from the proposed turbines in 2011, in accordance with protocol described in the 2011 Draft Eagle Conservation Plan Guidance. Stantec did not survey mapped nests along the Kennebec River in 2011, as these nests were checked by another surveyor just prior to the planned timing of Stantec's flight. In order to avoid disturbance to the nesting bald eagles, MDIFW recommended that Stantec avoid surveying these mapped nests and use the data obtained by MDIFW. Stantec did not conduct a second flight in 2011. Based on correspondence with MDIFW, the active nests within the survey area were again checked by another surveyor just prior to the planned timing of Stantec's second flight. In order to avoid disturbance, MDIFW again recommended that Stantec skip the second flight and use the data obtained by MDIFW. Therefore, all data from 2011 on known bald eagle nests along the Kennebec River and located within 10 miles of the project area were obtained from MDIFW.

Stantec did not perform aerial surveys around the project area in 2012. Data from 2012 provided in Table 1 below were obtained from MDIFW in January 2013, and are the results of aerial surveys and fledgling banding performed by NextEra Energy and Biodiversity Research Institute.

Survey Results

As shown on Table 1 and Figure 1, three active bald eagle nests have been identified within the vicinity of the proposed project. In 2010, Stantec surveyed within 4-miles of proposed turbine locations and did not identify any active bald eagle nests within this area. Nest #380B on the Kennebec River in Concord Township was found to be active during the survey, but was more than 4 miles from the nearest turbine location. Nest #509B in Bingham on the Kennebec River was also located in 2010, but it was found to be empty and inactive. Nest #509A was not located in 2010. In 2011, three active nests were identified within or immediately outside of 10 miles from the proposed turbines: nests #380B, #509A, and #301C on the Kennebec River in Carrying Place Township. Nest #509B was lot located in 2011 and nest #301C was greater than 10 miles from the proposed turbine locations. In 2012, nests #380B and #301C were also documented as active. According to MDIFW, nests #509A and #509B were inactive in 2012; however, a new nest in very close proximity to the #509B location was occupied and determined to be active. This nest was assigned #509C. For the purposes of measuring the distance to the nearest turbine, nests #509B and #509C were assumed to be in the same location. Note that occupancy has switched between the "A", "B", and "C" location at #509 over the past 3 years. Despite this switching, this is assumed to be the same pair of nesting eagles.

The closest active nest to the proposed project turbines in all years was #509B/C on the Kennebec River in Bingham at a distance of approximately 4.95 miles from the nearest proposed turbine location. No active bald eagle nests have been identified within 4 miles of the proposed turbine locations, the distance that the Maine Field Office of the USFWS has recommended for additional bald eagle surveys in Maine.[4] Two active bald eagle nests have been identified within 10 miles of the proposed turbine locations, the distance that the USFWS Draft Eagle Conservation Plan guidance recommends for bald eagle surveys nationwide.

In 2011, Stantec attempted to locate historic nest locations #301A, #301B, #112A, #380A, and #415A. These nests were not located during the 2011 surveys and have since been removed from MDIFW's database of bald eagle nests due to several years without activity or a nest being located.

Table 1. Historic Activity at Active and Historic Bald Eagle Nest Locations Surrounding the Bingham Wind Project

Waterbody	MDIFW Nest #	Distance to Nearest Turbine (mi)	2012 Status	2011 Status	2010 Status	Fall 2009 Status
Kennebec River	301C	12.17	Active – 1 eaglet	Active – 1 eaglet	Not Surveyed	Not surveyed
Kennebec River	509B/C	4.95	Active – 2 eaglets	Empty	Empty	Not located
Kennebec River	509A	n/a	Not located	Active – 1 eaglet	Not located	Not located
Kennebec River	380B	6.29	Active – 1 eaglet	Active – 1 eaglet	Active – 2 eaglets	Nest in good condition
Kennebec River	112A	n/a	Removed from IFW database	Not located – assumed down	Not surveyed	Not surveyed
Kennebec River	380A	n/a	Removed from IFW database	Not located – assumed down	Not located	Not located
Kennebec River	415A	n/a	Removed from IFW database	Not located – assumed down	Not surveyed	Not surveyed

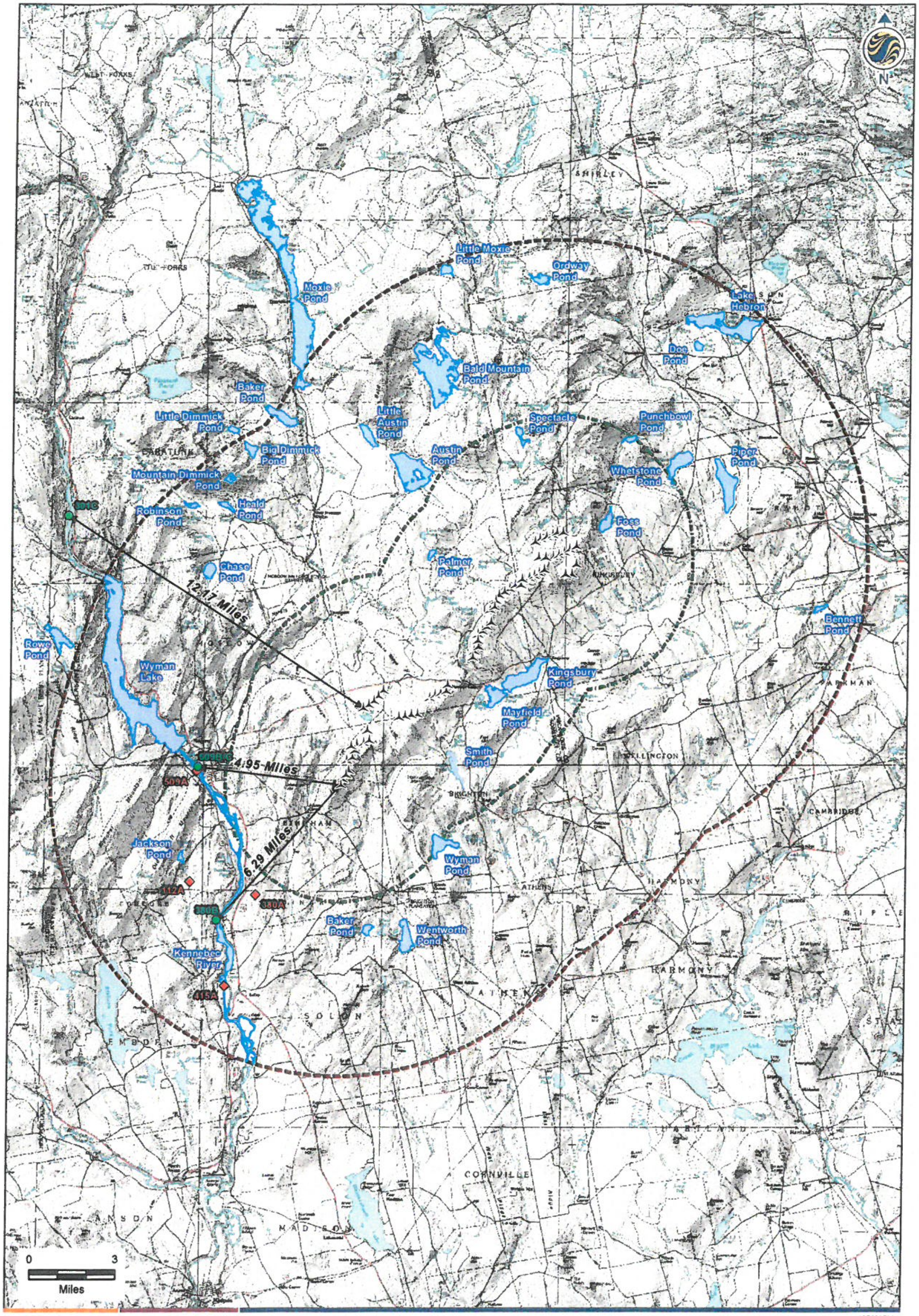
[4] U.S. Fish and Wildlife Service, March, 2012. *Guidelines for Building and Operating Wind Energy Facilities in Maine Compatible with Federal Fish and Wildlife Regulations.* U.S. Fish and Wildlife Service, Maine Field Office, Orono, ME.

Please contact our office if you have any questions regarding the information presented in this report or if we can be of further assistance.

STANTEC CONSULTING

Bryan Emerson
Project Manager

cc: Dale Knapp, Stantec
Adam Gravel, Stantec



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Stantec Consulting Services Inc.
30 Park Drive
Topsham, ME USA
04086
Phone (207) 729-1199
Fax: (207) 729-2715
www.stantec.com

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Legend

- Active Bald Eagle Nest
- Historic/Inactive Bald Eagle Nest Location
- Proposed Turbine (1/16/2013)
- Surveyed Waterbody
- 4 Miles from Turbines
- 10 Miles from Turbines

Client/Project
Blue Sky West, LLC
Bingham Wind Project
Bingham, Maine

Figure No.
1

Title
Active Bald Eagle Nests
3/12/2013

Exhibit 7D-1: Spring 2010 Pre-Construction Avian and Bat Survey Report

Spring 2010
Avian and Bat Survey Report
for the Bingham Wind Project
In Bingham, Mayfield, and Kingsbury, Maine

Prepared for

Blue Sky West Wind, LLC
129 Middle Street, 3rd Floor
Portland, ME 04101

Prepared by

Stantec Consulting Services Inc.
30 Park Drive
Topsham, ME 04086

Stantec

Rev. February 2012

Executive Summary

In advance of permitting activities for the proposed Bingham Wind Project (Project) in Somerset and Piscataquis Counties, Maine, Blue Sky West, LLC (Blue Sky) contracted Stantec Consulting Services Inc. (Stantec) to perform bird and bat surveys in 2010. The purpose of the field surveys was to evaluate bird and bat species presence and use of the Project area. Survey methods and work plans were developed based on past experience at other wind energy projects in the state. The work described in this report as well as the ongoing field surveys at the project were developed and discussed with the Maine Department of Inland Fisheries and Wildlife (MDIFW) and United States Fish and Wildlife (USFWS) staff at a meeting in Augusta, ME on March 5, 2010. This first season of wildlife field surveys for the Project included nocturnal marine radar surveys, bat detector surveys, raptor migration field surveys, breeding bird surveys, and aerial eagle nest surveys.* Summer/fall surveys are currently ongoing and the results of those studies will be presented in a separate report.

The Project is in the early stages of planning; however, current biological investigations include a series of four ridgelines extending approximately 15 miles northeast through the organized towns of Bingham, and unorganized townships of Mayfield and Kingsbury Plantation. The proposed turbines have a maximum height of 152 meters (m; 499 feet [']).

Nocturnal Radar Survey

Radar surveys were conducted during 20 nights in spring 2010 (between April 19 and May 26) to characterize nocturnal migration activity in the Project area. Surveys were conducted using X-band marine radar, sampling from sunset to sunrise. Each hour of sampling included the recording of radar video files during horizontal and vertical operation. The radar was located on the summit of an unnamed ridge just south of Route 16 in the town of Mayfield, located within the Project area. The radar location provided nearly unobstructed views of the surrounding airspace within the radar's range in all directions.

The overall mean passage rate for the entire spring survey period was 543 ± 30 targets per kilometer per hour (t/km/hr), and nightly passage rates varied from 51 ± 7 on April 29 to 1231 ± 202 t/km/hr on May 1. Mean flight direction through the Project area for the season was 43 ± 51°. The seasonal mean flight height of targets was 355 ± 1 m (1164') above the radar site, and nightly flight heights ranged from 156 ± 49 m (511') to 497± 96 m (1631'). The percent of targets observed flying below 152 m (499') was 21 percent for the entire season and varied by night, from 7 to 65 percent.

* The results of the aerial eagle survey were included in a Bald Eagle Nest Survey memo report dated June 30, 2010 and are not summarized in this report.

Bat Survey

The 2010 bat acoustic surveys were initiated in spring 2010 and the detectors will continue to operate through the fall 2010. This report presents the results of the spring surveys only, from April 13 through June 8. Eight acoustic detectors were deployed at five ridge top locations across the Project area. Three survey locations utilized meteorological (met) towers to elevate detectors at or above tree canopy height. Two additional locations did not have met towers, and therefore detectors were deployed at or below tree canopy height at these sites. At the recommendation of MDIFW, the majority of detectors were deployed at or below tree canopy height, however to document activity of long-distance migratory tree roosting species, those documented as most susceptible to collision with wind turbines, two detectors were deployed up high in two of the met towers to provide activity information above tree canopy height.

A total of 250 call sequences were recorded during the spring survey. Activity increased with decreasing detector height. Detectors deployed above tree canopy in met towers (n=2) had a combined detection rate of 0.16 call files recorded per detector-night (files/detector-night); detectors deployed at tree canopy height in met towers (n=3) had a combined detection rate of 0.31 files/detector-night; detectors deployed at or below tree canopy height (n=3) had a combined detection rate of 1.2 files/detector-night. Activity also increased over time during the spring survey period. The maximum activity recorded in a single night by all detectors occurred on May 28 (27 total calls for all detectors combined).

Of those calls that could be identified to species or guild, the Myotis guild (MYSP) contained the highest number of call sequences (n = 92) identified to a taxonomic level. Tree detectors recorded calls from all five guilds (MYSP, Unknown, eastern red bat/tri-colored bat (RBTB), big brown bat, silver-haired bat and hoary bat), while met tower detectors recorded call sequences from all guilds except the RBTB guild.

Diurnal Raptor Survey

Spring 2010 raptor migration surveys were conducted on 10 days from mid-March (March 19) through late-May (May 21). Five of those survey days were conducted at the two observation locations simultaneously (April 30, May 5, May 13, May 18, and May 21), for a total of 15 observation days (5 days at Johnson Ridge and 10 days at Kingsbury Ridge). A total of 105 hours were surveyed (70 hours at Kingsbury Ridge and 35 hours at Johnson Ridge).

Over the course of the survey period a total of 56 observations of raptors were made from both observation locations combined;19 observations from Kingsbury and 37 observations from Johnson. Two of these observations,1 turkey vulture (*Cathartes aura*) on May 5, and 2 turkey vultures on May 21, were thought to be simultaneous observations between the observers at Kingsbury and Johnson Ridges based on their flight directions and behavior. The seasonal passage rate for Kingsbury Ridge was 0.27 raptor observations per hour (raptors/hr); the seasonal passage rate for Johnson Ridge was 1.06 raptors/hr. Based on flight direction and behavior, the majority of birds observed were suspected to be seasonally local birds.

Of the 56 total raptor observations made within the study area at both observation locations combined, 34 (61%) observations occurred specifically within the Project area. In particular, 21 raptor observations occurred over Johnson Ridge and 13 observations occurred over Kingsbury Ridge. All other observations occurred either over hills, peaks, or valleys outside of the Project area.

At Johnson Ridge, 21 observations (57%) occurred within the Project area in topographical positions where the turbines are to be sited. Of these birds, 20 (95% of the 21 in the Project area) occurred at flight heights below the proposed maximum rotor height of 152 m. At Kingsbury Ridge, 13 observations (68%) occurred within the Project area in positions where the turbines are to be sited. Of these birds, 10 birds (77% of the 13 in the Project area) occurred at flight heights below the proposed maximum rotor height.

The most commonly observed species at both survey locations were turkey vultures. No endangered or threatened species were observed. Six observations of bald eagle (*Haliaeetus leucocephalus)*, a state-listed species of special concern, were made in the study area, four of which were made on May 25. Four of the six bald eagle observations occurred within the Project area. Of these, two adult bald eagles were observed near (at 150 m) and above 152 meters above the ground, one sub-adult bald eagle was observed flying between 50 and 100 meters, and another sub adult was observed flying over 500 meters above the ridge.

Breeding Bird Survey

In order to assess the assemblage of species of breeding birds within the Project area, a breeding bird survey (BBS) was conducted in late spring and summer 2010. Stantec biologists conducted breeding bird point-count surveys during three separate visits to the Project area. The first visit was completed during late May, the second visit in early June, and third visit in late June 2010.

The BBS surveys consisted of 25, 10-minute point count surveys positioned at locations along the ridgelines of the Project area. Survey points were positioned in various habitats within the Project area including coniferous forest, hardwood forest, equally mixed hardwood-coniferous forest, coniferous-dominated mixed forest, and hardwood-dominated mixed forest. Much of the Project area has been harvested either recently or historically or has been otherwise managed. As a result of this land use, many survey points occurred in forest stands in various stages of regeneration or within tree plantations.

A total of 787 individuals were documented among all survey points, including birds observed beyond 100 m from the observer and birds observed as flyovers. The species with the greatest numbers of individuals detected were white-throated sparrow (*Zonotrichia albicollis*; n=89), ovenbird (*Seiurus aurocapillus*; n=62), chestnut-sided warbler (*Dendroica pensylvanica*; n=53), and Nashville warbler (*Vermivora ruficapilla*; n=52).

There were a total of 673 individuals observed within 100 m of the observer and excluding flyovers. Excluding birds more than 100 m from the observer and flyovers, point-count data were analyzed to determine species richness, relative abundance, and community diversity for all survey points combined and for each habitat type present within the Project area. For all survey points and for birds within 100 m and non-flyovers, the relative abundance was 8.97, the species richness was 44, and the Shannon Diversity Index was 3.19.

Hardwood-dominated mixed forest habitat had the greatest number of total birds observed (n=179), the highest species richness (32), as well as the highest Shannon Diversity Index (3.04). Coniferous-dominated mixed forest had the highest relative abundance (10.89).

There were no endangered or threatened species observed; however, there were nine state special concern species documented either during surveys or incidentally: least flycatcher (*Empidonax minimus*), eastern wood-pewee (*Contopus virens*), veery (*Catharus fuscescens*), American redstart (*Setophaga ruticilla*), black-and-white warbler (*Mniotilta varia*), Canada warbler (*Wilsonia canadensis*), chestnut-sided warbler, yellow-warbler (*Dendroica petechia*), and white-throated sparrow.

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PN195600539[†]

[†] *This report was prepared by Stantec Consulting Services Inc. for the Bingham Wind Project for Blue Sky West, LLC. The material in it reflects Stantec's judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. Stantec accepts no responsibility for damages, if any suffered by any third party as a result of decisions made or actions based on this report.*

1.0 Introduction

1.1 PROJECT BACKGROUND

In advance of permitting activities for the proposed Bingham Wind Project (Project) in Somerset and Piscataquis Counties, Maine, Blue Sky West, LLC (Blue Sky) contracted Stantec Consulting Services Inc. (Stantec) to perform bird and bat surveys in 2010. The purpose of the field surveys was to evaluate bird and bat species presence and use of the Project area. Survey methods and work plans were developed based on past experience at other wind energy projects in the state. The work described in this report as well as the ongoing field surveys at the project were developed and discussed with the Maine Department of Inland Fisheries and Wildlife (MDIFW) and United States Fish and Wildlife (USFWS) staff at a meeting in Augusta, ME on March 5, 2010. This first season of wildlife field surveys for the Project included nocturnal marine radar surveys, bat detector surveys, raptor migration field surveys, breeding bird surveys, and aerial eagle nest surveys.[3] Summer/fall surveys are currently ongoing and the results of those studies will be presented in a separate report.

The Project is in the early stages of planning; however, current biological investigations include a series of four ridgelines extending approximately 15 miles northeast through the organized towns of Bingham, and unorganized townships of Mayfield and Kingsbury Plantation. The proposed turbines have a maximum height of 152 meters (m; 499 feet [']).

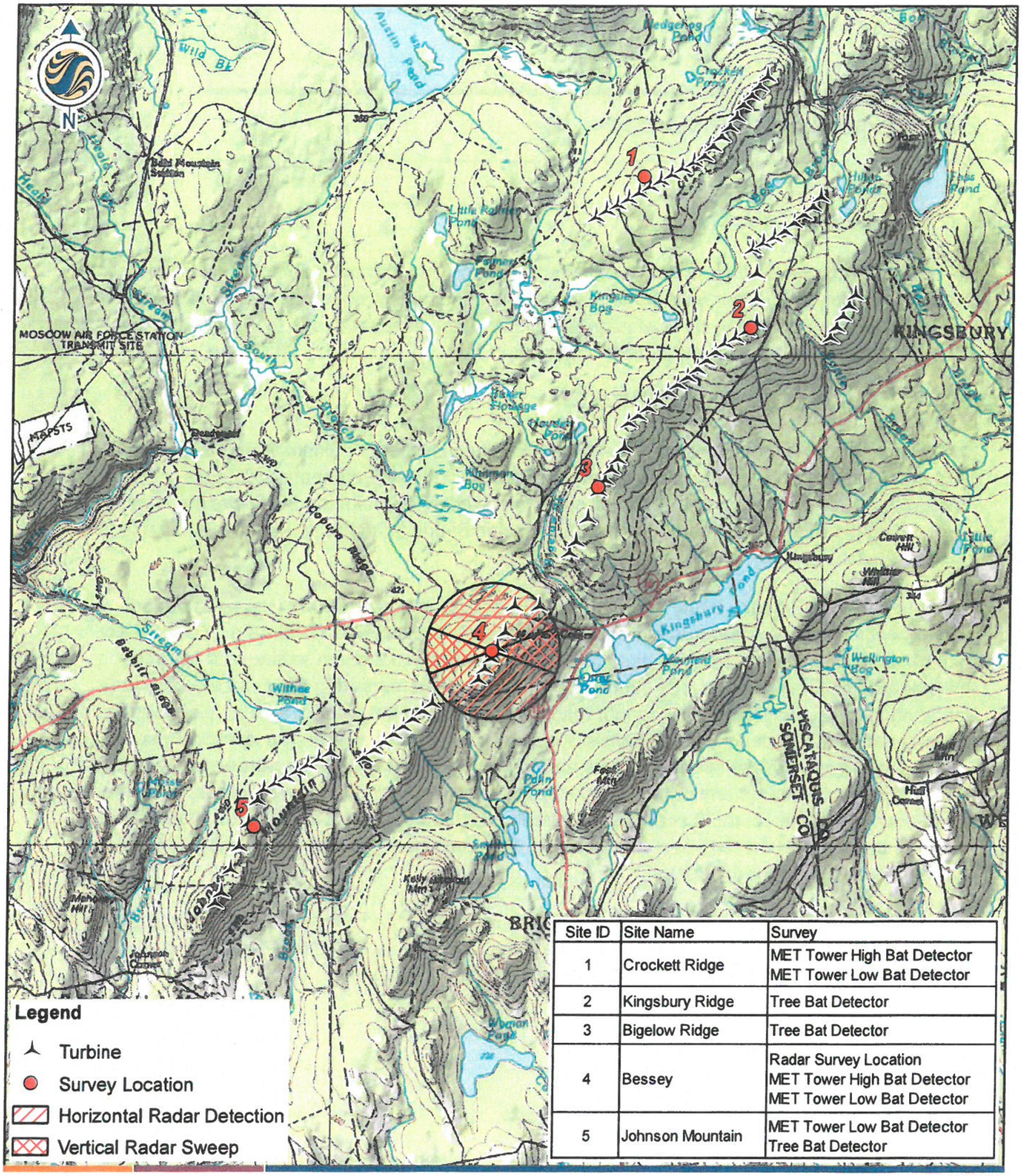
1.2 PROJECT AREA DESCRIPTION

The Project area is located within the Central and Western Mountains Ecoregion as defined in *Maine's Comprehensive Wildlife Conservation Strategy* (MDIFW 2005). This ecoregion is a consolidation of the Western Mountains and Central Mountains biophysical regions originally described by McMahon (1990). The Central and Western Mountains Ecoregion extends from the New Hampshire border south the White Mountains National Forest, north to Aroostook County and east to the western foothills. The average elevation within the western portion of the ecoregion (former Western Mountain Biophysical Region) is between approximately 305 m to 610 m (1,000' to 2,000') with several peaks exceeding 823 m (2,700'). The northern portion of this ecoregion includes some of the highest peaks in the state and has elevations that range from 183 m to 1,603 m (600' to 5,258'). The climate of this ecoregion is characterized by relatively low annual precipitation and cool temperatures. Heavy snow fall prolongs the winter resulting in a relatively short growing season (McMahon 1990). In general, ridge tops within this ecoregion are dominated by red spruce (*Picea rubens*) and balsam fir (*Abies balsamea*) with lower elevations supporting deciduous species such as sugar maple (*Acer saccharum*), yellow birch (*Betula alleghaniensis*) and American beech (*Fagus grandifolia*).

[3] The results of the aerial eagle survey were included in a Bald Eagle Nest Survey memo report dated June 30, 2010 and are not summarized in this report.

The Project area is located on a series of ridgelines that do not exceed 494 m (1620') in elevation. These include Johnson and Crockett ridges and an unnamed mountain in Kingsbury. The unnamed mountain and Crockett ridgelines are separated by Bog Brook and Kingsley Bog. Crockett Mountain has the highest elevation reaching up to 494 m. The unnamed mountain is the next highest in elevation reaching nearly 268 m; and Johnson Mountain reaches 241 m.

Historically and presently, the land within and surrounding the Project area, including the summits of the ridgelines, have been used for commercial timber management. This is evident by the recent and past cuts as well as the presence of the network of haul roads that extend through the Project area. Due to timber harvesting activities much of the forest stands within the Project area are in various stages of regeneration. Additionally, softwood plantations are present along some of the ridgelines.



Site ID	Site Name	Survey
1	Crockett Ridge	MET Tower High Bat Detector MET Tower Low Bat Detector
2	Kingsbury Ridge	Tree Bat Detector
3	Bigelow Ridge	Tree Bat Detector
4	Bessey	Radar Survey Location MET Tower High Bat Detector MET Tower Low Bat Detector
5	Johnson Mountain	MET Tower Low Bat Detector Tree Bat Detector

Legend

- Turbine
- Survey Location
- Horizontal Radar Detection
- Vertical Radar Sweep

195600539

Stantec Consulting Services Inc.
30 Park Drive
Topsham, ME USA
04086
Phone (207) 729-1199
Fax: (207) 729-2715
www.stantec.com

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Miles

Client/Project
Bingham Wind Project
Bingham, Maine

Figure No.
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Title
Project Area and Spring 2010 Radar and Bat Acoustic Survey Locations Map

August 20, 2010

00539-F11-BatRadar.mxd

2.0 Nocturnal Radar Survey

2.1 INTRODUCTION

Nocturnal radar surveys were conducted in the Project area to characterize nocturnal migration patterns in spring 2010. The goal of the surveys was to document nocturnal migration in the Project area, including the number of migrants, nightly and seasonal passage rates, the flight direction of migrants, and flight altitude of migrants.

2.2 DATA COLLECTION METHODS

The radar site was located within the met tower clearing just south of Route 16 in Mayfield. This location was selected due to its nearly central location within the Project area. The site's topography and surrounding tree height allowed for relatively unobstructed views of the airspace surrounding the radar. Radar surveys were conducted during 20 nights between April 19 and May 26, 2010

Marine surveillance radar, similar to that described by Cooper *et al.* (1991), was used during field data collection. The radar has a peak power output of 12 kilowatts (kW) and has the ability to track small animals, including birds, bats, and even insects, based on settings selected for the radar functions. Insects can be identified and removed from the migration calculations based on flight speed; however, it cannot readily distinguish between different types of animals being detected. Consequently, all animals observed on the radar screen (not including insects) were identified as "targets." The radar has an "echo trail" function which captures past echoes of flight trails, enabling determination of flight speed and direction. During all operations, the radar's echo trail was set to 30 seconds. The radar was equipped with a 2 m (6.5') waveguide antenna, deployed 7.3 m (24') above ground. The antenna has a vertical beam width of 20° (10° above and below horizontal).

Objects on the ground detected by the radar cause returns on the radar screen (echoes) that appear as blotches called ground clutter. Large amounts of ground clutter reduce the ability of the radar to track birds and bats flying over those areas (Figure 2-1).

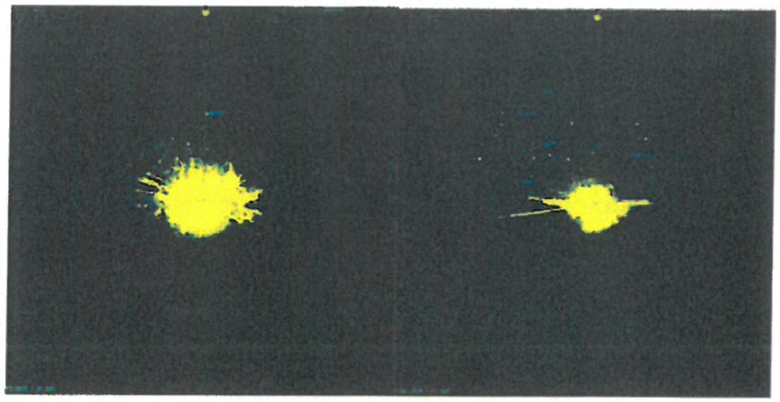

Figure 2-1. Screenshots from actual radar video files for the Bingham Wind Project showing ground clutter in horizontal mode (left) and vertical mode (right). Although the radar records three-dimensional space, it is translated by the radar screen into a two dimensional representation. For this reason ground clutter if not minimized with proper site configuration can cause targets to be obscured from view.

However, vegetation and hilltops near the radar can be used to reduce or eliminate ground clutter by "hiding" clutter-causing objects from the radar (Figure 2-2). These nearby features also cause ground clutter, but their proximity to the radar antenna generally limits the ground clutter to the center of the radar screen. However, targets traveling into and out of the ground clutter areas can be tracked. The presence or reduction of potential clutter producing objects was carefully considered during site selection and radar station configuration.

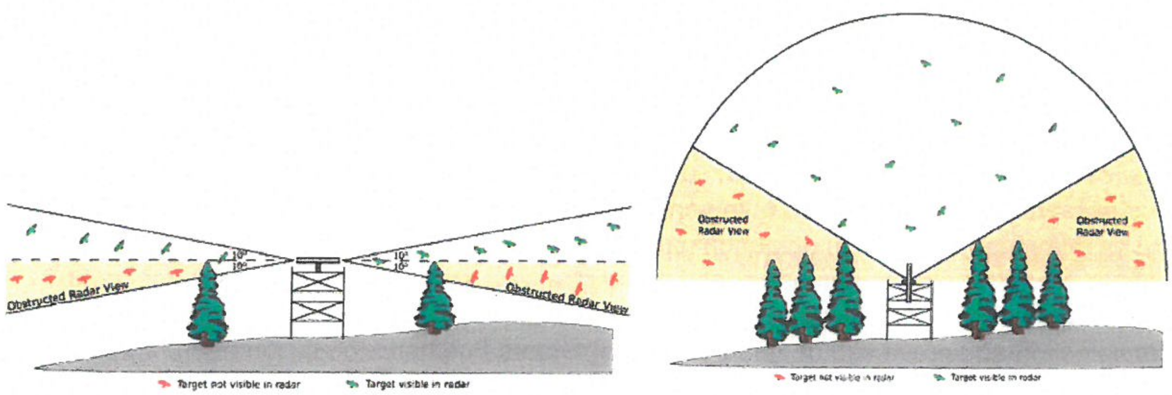

Figure 2-2. An example of ground clutter "hiding" a section of the radar beam, allowing adequate detection of targets (left). The effect of ground clutter on target detection in vertical mode is also shown (right).

Because the anti-rain function of the radar must be turned down to detect small songbirds and bats, surveys could not be conducted during active rainfall. Therefore, surveys were planned largely for nights without rain. However, in order to characterize migration patterns during nights without optimal conditions, some nights with weather forecasts including occasional showers, mist, or fog were sampled.

The radar was operated in two modes throughout the course of each night. In surveillance mode, the antenna spins horizontally to survey the airspace around the radar and detects the number of targets and their flight direction as they pass through the project site (Figure 2-1). By analyzing the echo trail, the flight direction and flight speed of targets can be determined.

In vertical mode, the radar unit is tilted 90° to vertically survey the airspace above the radar (Harmata *et al.* 1999). In vertical mode, target echoes do not provide directional data, but do provide information on the altitude of targets passing through the vertical, 20° radar beam (Figure 2-3). Both modes of operation were used during each hour of sampling.

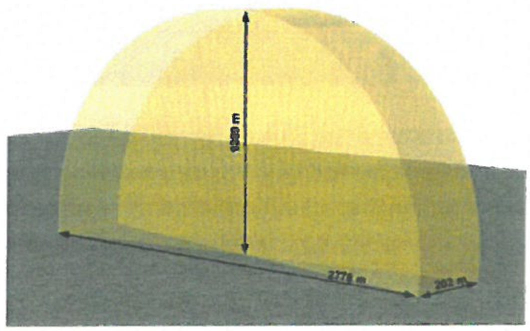

Figure 2-3. Detection range of the radar in vertical mode

The radar was operated at a range of 1.4 km (0.75 nautical miles [4,500']) to ensure detection of small targets. When radar is operated at greater ranges, larger birds can be detected but the echoes of small birds are reduced in size and restricted to a smaller portion of the radar screen, thus limiting the ability to observe the movement pattern of individual targets.

The radar display was connected to the video recording software of a computer enabling digital archiving of the radar data for subsequent analysis. This software recorded and archived video samples continuously every hour from sunset to sunrise of each survey night. By alternating the radar antenna every ten minutes from vertical mode to horizontal mode, a total of 30 minutes of vertical samples and 30 minutes of horizontal samples were collected within each hour. A stratified random sample set was developed by randomly selecting 6 horizontal samples and 6 vertical samples per hour of survey. This sampling schedule allowed for randomization of sample selection and prevented double-counting of targets due to the 30-second echo trail used.

2.2.1 Weather Data

Temperature, wind speed and direction were recorded by the on-site met tower on Bessey Ridge. Surface weather maps, prepared by the National Centers for Environmental Prediction, the Hydro-meteorological Prediction Center, and the National Weather Service, were downloaded daily for the majority of the survey period.

2.3 DATA ANALYSIS METHODS

2.3.1 Radar Data

Video samples were analyzed using a digital analysis software tool developed by Stantec. For horizontal samples, targets (either birds or bats) were differentiated from insects based on their flight speed. Following adjustment for wind speed and direction, targets traveling faster than approximately 6 m (20') per second were identified as a bird or bat target (Larkin 1991, Bruderer and Boldt 2001). The software tool recorded the time, location, and flight vector for each target traveling fast enough to be a bird or bat within each horizontal sample, and these results were output to a spreadsheet. For vertical samples, the software tool recorded the entry point of targets passing through the vertical radar beam, the time, and flight altitude above the radar location, and then subsequently outputs the data to a spreadsheet. These datasets were then used to calculate passage rate (reported as targets per kilometer of migratory front per hour), flight direction, and flight altitude of targets.

Mean flight directions (± 1 circular standard deviation) were summarized using software designed specifically to analyze directional data (Oriana2© Kovach Computing Services). The statistics used for this analysis are based on those used by Batschelet (1965), because they take into account the circular nature of the data.

Flight altitude data were summarized using linear statistics. Mean flight altitudes (± 1 standard error [SE]) were calculated by hour, night, and overall season. The percent of targets flying below 152 m (499'), the approximate maximum height of the proposed wind turbines with blades, was also calculated hourly, for each night, and for the entire survey period.

2.3.2 Weather Data

The mean, maximum, and minimum temperature, hourly wind speed, and hourly wind direction were calculated for each night of the survey period. This information was used during data analysis to help characterize any patterns in migration activity for particular nights and for the season overall. In addition, in order to consider the atmospheric influences on migration, regional surface weather map images were interpreted to determine the dates that daytime pressure systems (high, low, or none) moved through the region.

2.4 RESULTS

Radar surveys were conducted during 20 nights between April 19 and May 26, 2010 (Appendix A Table 1) resulting in 184 total hours surveyed. The radar location provided nearly unobstructed views of the airspace within the range of the radar in all directions.

2.4.1 Passage Rates

The overall passage rate for the entire survey period was 543 ± 30 t/km/hr. Nightly passage rates varied from 51 ± 7 targets per kilometer per hour (t/km/hr) on April 29 to 1231 ± 202 t/km/h on May 1, (Figure 2-4, Appendix A Table 1). Individual hourly passage rates varied between and within nights and throughout the season, and ranged from 0 t/km/hr on the 10th hour of May 6 to 2193 t/km/hr on the 7th hour of May 1 (Appendix A Table 2). For the entire season, passage rates were typically highest during the third hour after sunset, and then steadily declined until sunrise (Figure 2-5).

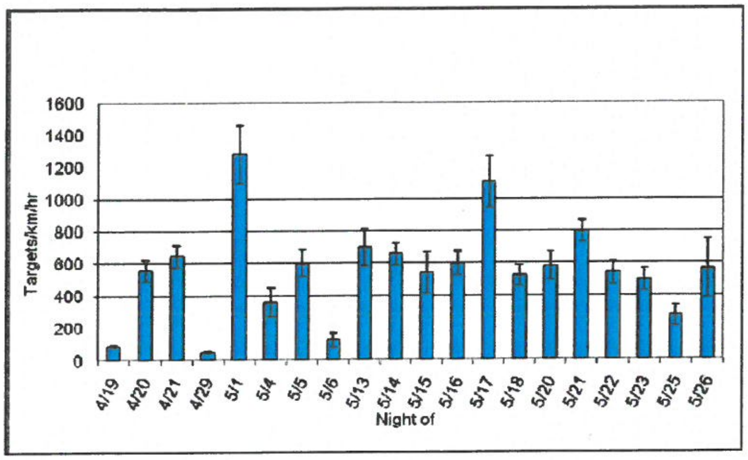

Figure 2-4. Nightly passage rates observed (error bars ± 1 SE) during Spring 2010 at the Bingham Wind Project.

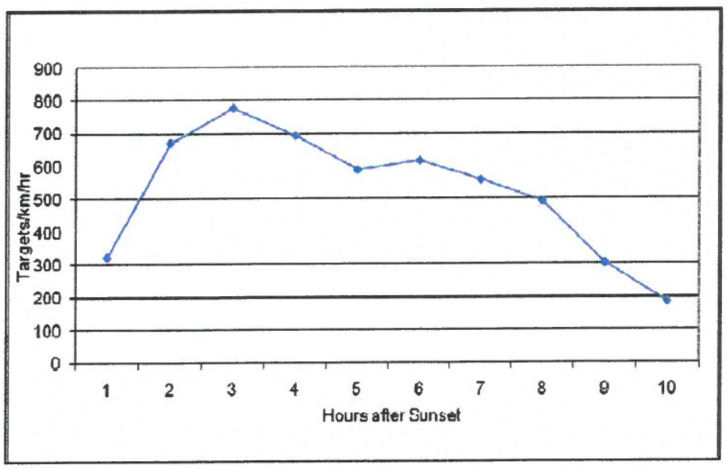

Figure 2-5. Hourly passage rates for entire season during Spring 2010 at the Bingham Wind Project

2.4.2 Flight Direction

Mean flight direction through the Project area was 43 ± 51°(Figure 2-6). Overall, the mean flight direction was to the northeast, but varied between nights (Appendix A Table 3).

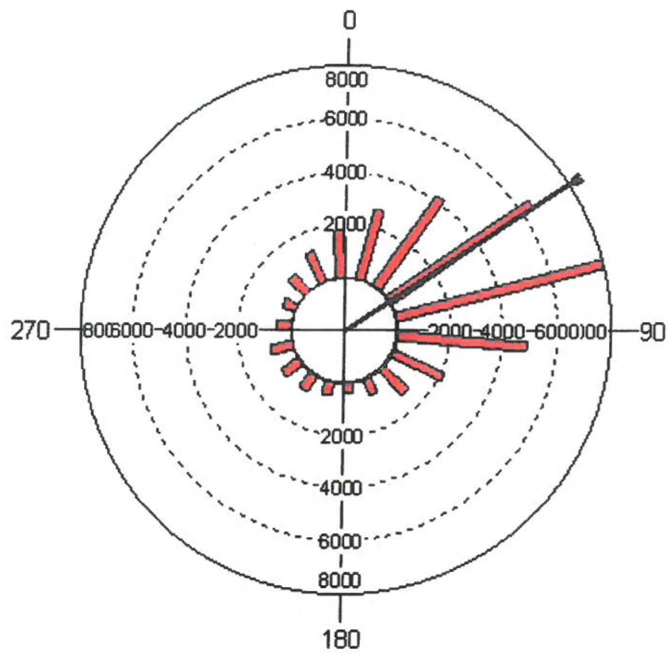

Figure 2-6. Mean flight direction for the entire season during Spring 2010 at the Bingham Wind Project (the bracket along the margin of the histogram is the 95% confidence interval)

2.4.3 Flight Altitude

The seasonal average mean flight height of all targets was 355 ± 1 m 1164) above the radar site. The average nightly flight height ranged from 156 ± 49 m (511') on May 15 to 497 ± 96 m (1631') on April 21 (Figure 2-7, Appendix A Table 4). The percent of targets observed flying below 152 m was 21 percent for the season and varied nightly from 7 percent on May 5 to 65 percent on May 15 (Figure 2-8).

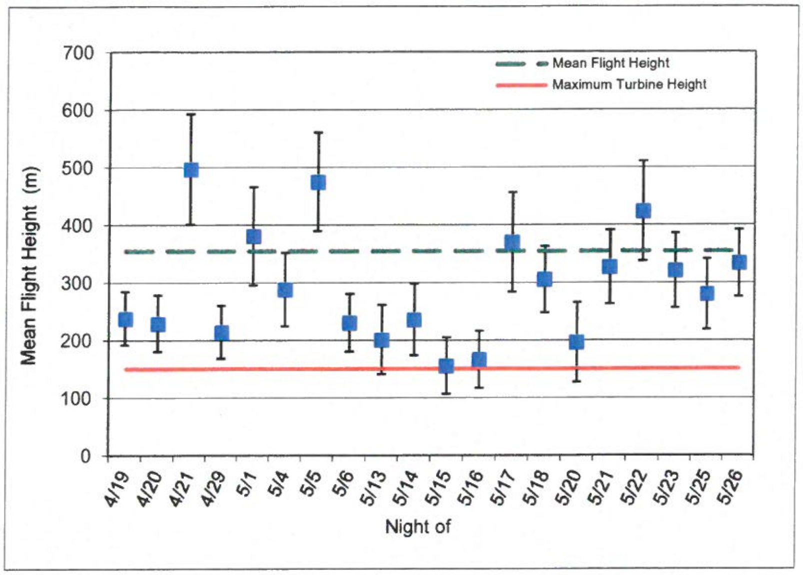

Figure 2-7. Mean nightly flight height of targets during Spring 2010 at the Bingham Wind Project (error bars ± 1 SE)

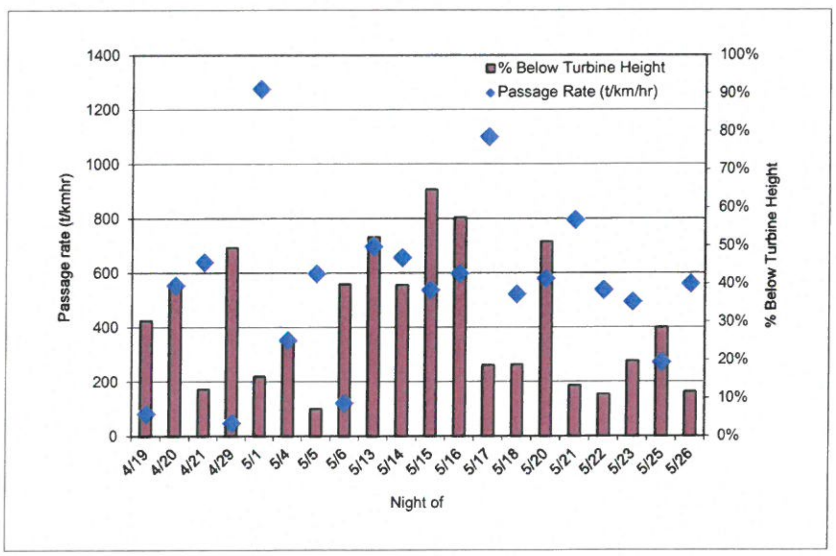

Figure 2-8. Percent of targets observed flying below a height of 152 m (499') during Spring 2010 at the Bingham Wind Project

Figure 2-9 below displays the range in nightly flight heights to graphically show the distribution of individual flight heights of all targets recorded each survey night relative to the proposed turbine height. The "blocks" seen on Figure 2-9 depict the middle 50 percent of targets. The error bars depict the statistical outliers, or 25 percent of targets above and below the middle 50% of targets. The horizontal line within each box represents the median flight height value for that night.

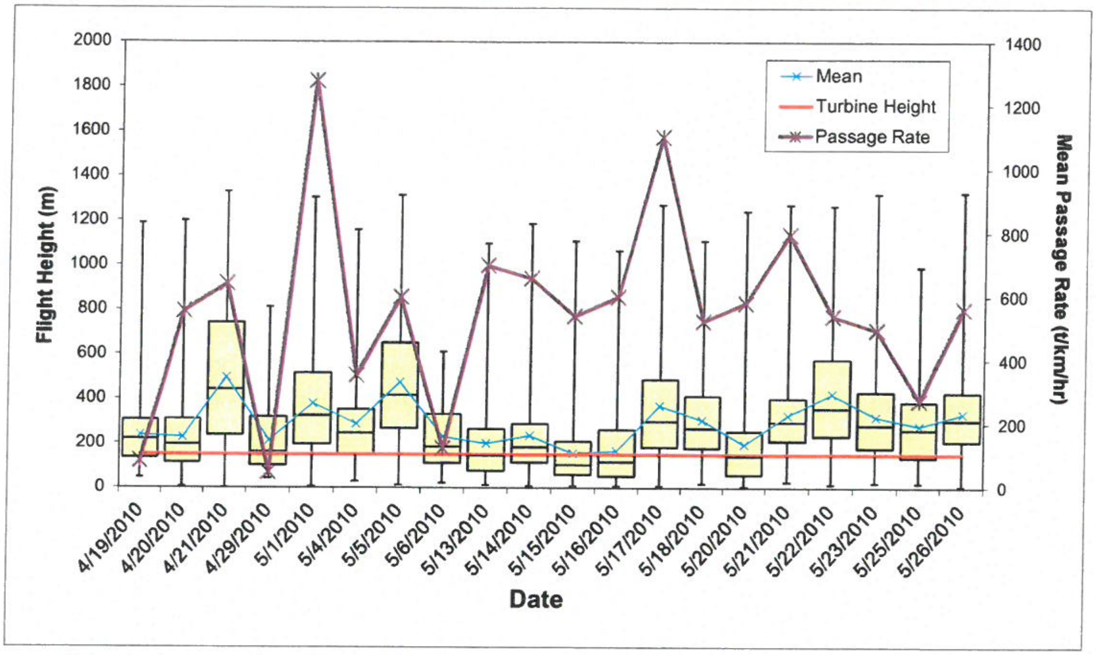

Figure 2-9. Flight height Whisker plot depicting the vertical distribution of targets for each survey night during Spring 2010 at the Bingham Wind Project

For the entire season, the mean hourly flight heights were typically highest during the second hour after sunset, with a second spike in the tenth hour (Figure 2-10).

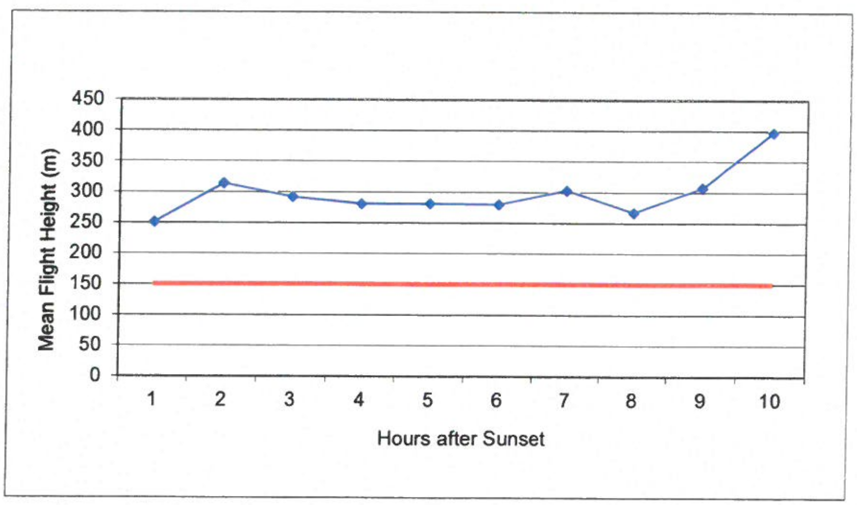

Figure 2-10. Hourly target flight height distribution during Spring 2010 at the Bingham Wind Project

2.4.4 Weather Data

During the survey period, mean nightly wind speeds in the Project area varied between 2.7 meters per second (m/s) on May 17 and 12.9 m/s on May 6, with an overall mean of 7.0 m/s.

Mean nightly temperatures varied between 4.8 °C on April 19 and 15.5 °C on May 1, with an overall mean of 10.0°C.

Analysis of regional surface weather maps reveals that spring 2010 surveys were conducted during periods of high atmospheric pressure and favorable conditions for migration.

2.5 DISCUSSION

Spring radar surveys in the Project area documented similar nocturnal migration patterns to those observed during other recent radar surveys conducted in the eastern US (Appendix A Table 5). These include highly variable passage rates between nights, a generally northward flight direction, and flight heights primarily occurring between 200 and 500 m above the ridgeline.

The increasingly emerging number of publicly available studies characterizing nocturnal migration movements shows a relatively consistent pattern in flight altitude, with most targets appearing to fly at altitudes of several hundred meters or more above the ground (Appendix A Table 5). Flight heights are typically highest during the third to fifth hours after sunset, and then decreased until sunrise for other surveys conducted in the eastern US. Flight heights between hours within and among nights at the Project showed a slight increase between the first and second hours, remained consistent between the second and ninth hours, and appeared to increase during the tenth hour after sunset. The increase in flight heights in the tenth hour after sunset is fairly unusual when compared to flight height trends within and among nights at other projects; however, this may be due to the fact that no data were available for flight height during the tenth hour of 13 out of 20 nights due to too few samples in that hour as a result of increased daytime hours as the season progressed.

Characteristics of individual radar sites, particularly 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 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. The radar location was nearly centrally located within the Project area. Consequently, the radar site had good visibility and was capable of detecting targets within nearly all of its detection range. The average passage rate at the Project (543 ± 30 t/km/hr) is within the range of results of other radar studies conducted in Maine and the northeast (Appendix A Table 5). Comparison of passage rates between radar surveys at the Project and similar surveys conducted at other sites must be done with caution, as differences in passage rates are due in large part to differences in radar view between sites, and not necessarily the amount of migration above a radar site.

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). For the 2010 spring radar surveys, high pressure systems were either present or had passed through the region just prior to nights of relatively high passage rates (May 1, May 13 and May 17). The sharp difference between passage rates on April 29 and May

1, the nights with the lowest and highest average passage rates, respectively, is likely due to the passage of a high pressure system. A low pressure system had stalled over the area for several days at the end of April causing heavy cloud cover, precipitation and northwest winds. Once a high pressure system moved through the area, allowing a break in weather, migration conditions improved as was reflected in the high passage rate on the night of May 1. Winds were generally light and from the southwest or southeast during the two nights with the highest passage rates (1231 t/km/hr on May 1 and 1103 t/km/hr on May 17). The average temperatures for these nights were also higher than on nights prior to or following these peaks.

The average flight height (355 ± 1 m) is within the range of average flight heights recorded at other radar studies conducted in the east (210 m to 552 m), and the overall percent below turbine height (21%) for all targets falls within the range of other results (4% to 26%). No nights experienced average flight heights below 152 m, the maximum height of the proposed turbines. Additionally all targets within the 50th percentile for each night were above the proposed turbine height (Figure 2-9).

For the 2010 spring Project surveys, flight heights were generally highest on nights with relatively high passage rates (349 ± 31 m on May 1 and 357 ± 33 m on May 17), indicating that birds tend to fly higher on nights more suitable for migration. On April 29, both average passage rate (51 ± 7 t/km/hr) and flight height (214 ± 46 m) were relatively low, most likely due to the inclement weather on that night which may have limited migration activity and "pushed" birds closer to the ground.

In summary, results at the Project are within the range of results recorded at other radar studies conducted in the eastern US, and provide a sample of baseline migration activity over the Project during spring 2010.

3.0 Acoustic Bat Survey

3.1 INTRODUCTION

Bats use high frequency echolocation to maneuver through the landscape during migration or in search of food and water. Although the echolocation sounds produced by bats are above the human range of hearing, electronic equipment can be used to record these high frequency sounds. Acoustic sampling of bat activity has become a standard element of pre-construction surveys for proposed wind-energy developments. Acoustic sampling allows for simultaneous data collection at varying heights at or below canopy tree height and across long time periods (Kunz *et al.* 2007); as a result, these surveys can provide insight into altitudinal and seasonal patterns of bat activity. While this type of data collection cannot determine the number of individuals found in the area, and is associated with several major assumptions (Hayes 2000), it can be used to examine activity trends for certain species or species groups, and may be useful in predicting potential post-construction mortality patterns.

Eight species of bats occur in Maine, 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*) (BCI 2001). Of these, all but the big brown bat is listed as a species of special concern in the state.

The objective of acoustic surveys at Bingham were (1) to document bat activity patterns from April to October in airspace near the rotor zone of the proposed turbines, at an intermediate height, and near the at or below tree canopy height; and (2) to document bat activity patterns in relation to weather factors including wind speed, temperature, and relative humidity. Information in this report covers the 2010 spring migratory period from the beginning of the survey in mid-April through early June. Subsequent reports will cover the summer maternity season and fall migration period.

3.2 METHODS

3.2.1 Data Collection

Anabat SDI detectors (Titley Electronics Pty Ltd.) were selected for data collection based upon their widespread use for this type of survey, their ability to be deployed for long periods of time, and their ability to detect a broad frequency range, which allows detection of all species of bats which could occur in the Project area. Anabat detectors are frequency division detectors, dividing the frequency of echolocation sounds made by bats by a factor of 16, and then recording these sounds onto removable compact flash cards for subsequent analysis. Detectors were programmed to begin monitoring at 19:00 hours each night and end monitoring at 08:00 hours each morning, and were visited approximately every two weeks to check the condition of the detectors and to download recorded data. The audio sensitivity setting of each Anabat system was set between six and seven (on a scale of one to ten) to maximize sensitivity while limiting ambient background noise and interference. The sensitivity of individual detectors was then tested using an ultrasonic Bat Chirp (Reno, NV) to ensure that the detectors would be able to detect bats up to a distance of at least 10 m (33').

Each Anabat detector was powered by 12-volt batteries charged by solar panels. Each solar-powered Anabat system was deployed in waterproof housing enabling the detector to record while unattended for the duration of the survey. The housing suspends the Anabat microphone downward to give maximum protection from precipitation. To compensate for the downward position, a curved plastic joint was used to funnel sound into the downward-facing microphone, allowing the microphone to record the airspace horizontally surrounding the detector.

3.2.2 Site Selection

Acoustic survey sites at Bingham were chosen based on professional opinion of how bats might move across the Project area. Currently, pre-construction acoustic methods emphasize monitoring a vertical array of airspace to document species flying at all altitudes (Arnett *et al.* 2006, Kunz *et al.* 2007, Reynolds 2006). Fatalities occur when individuals collide with turbines (Horn *et al.* 2008) or come in close proximity to spinning blades, which can result in rapid decompression that leads to death as a result of barotrauma (Baerwald *et al.* 2008). Detectors placed at or near rotor-swept height assess flight activity at heights relevant to assessing risk of fatality. Also, detectors deployed above canopy height more readily survey long-distance migrants; these species generally fly and forage at high altitudes, and are species that experience the highest turbine collision rates (Arnett *et al.* 2008). At or below tree canopy height detectors are deployed because (1) resident bat species generally forage close to, or below, the tree canopy, (2) activity is often greater at or below tree canopy height, so these detectors assist with species presence and activity patterns, and (3) bats present at or below tree canopy height could potentially become attracted to the height of rotating blades (Cryan and Barclay 2009, Kunz *et al.* 2007). Detectors deployed at intermediate heights are used to fill in the vertical array to get a complete picture of species composition and airspace use within the Project area.

Eight acoustic detectors were deployed at five ridge top locations across the proposed Project area (Figure 1-1). Three survey locations utilized meteorological (met) towers to elevate detectors above tree canopy height. Two additional locations did not have met towers, and therefore detectors were deployed in trees at or below tree canopy height at these sites.

Two acoustic bat detectors were placed in the Bessey Met Tower on April 13, 2010 (Figure 3-1). The high detector was raised to an approximate height of 40 m and the low detector was raised to approximately 20 m. The met tower clearing is located approximately a half mile south of Route 16 in Mayfield. The elevation at the tower is 474 m (1,555'). The forest composition surrounding the met clearing is made up of sapling to pole size mixed hardwoods with scattered log sized spruce.

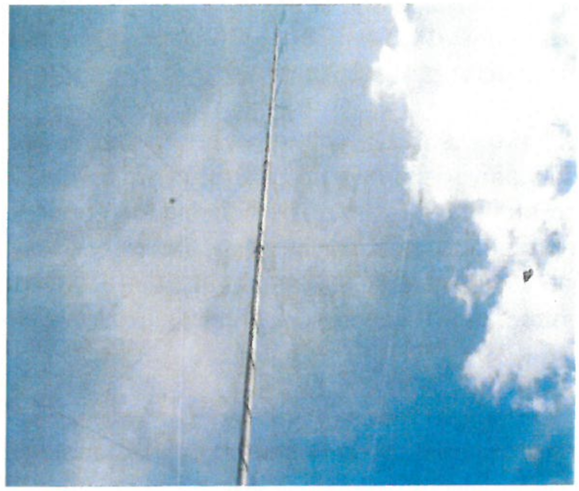

Figure 3-1 Bessey Met Detectors (High and Low).

One acoustic bat detector was placed in a spruce tree on April 14, 2010 at an approximate height of 5 m on Bigelow Ridge (Figure 3-2). This location is on the south end of the ridgeline which runs parallel to Old Hayden Pond Road and Bigelow Brook. The elevation at the site is 466 m (1,529'). The tree detector was placed in a small opening at the end of an old skid trail. The forest surrounding the area is spruce plantation with an approximate tree height of 3 to 5 m.

Figure 3-2 Bigelow Ridge Tree Detector.

Two acoustic bat detectors were placed in the met tower located on the ridgeline just south of Crockett Mountain (Figure 3-3). The elevation at the tower is 459 m (1,504'). The high detector was raised to an approximate height of 40 m and the low detector was raised to an approximate height of 20 m. The met tower clearing is about 300 m in diameter and is surrounded by dense regenerating spruce-fir as well as sapling to mature sized hardwoods. The tree height in the area varies from approximately 5 m to 15 m.

Figure 3-3 Crockett Met Detectors (High and Low).

One acoustic bat detector was placed in a spruce tree on the northern edge of the met tower clearing on Johnson Ridge on April 14, 2010 (Figure 3-4). The elevation at the tower is elevation 439 m (1,440'). The detector was deployed at an approximate height of 5 m. This tree is located adjacent to a small forested wetland and regenerating spruce-fir growth at the edge of the met clearing. The surrounding forest is mixed with sapling to mature hardwoods as well as seedling to mature softwood scattered with dead snags and areas of dense regeneration.

Figure 3-4 Johnson Met Tree Detector.

One acoustic bat detector was placed in the met tower on Johnson Ridge on April 14, 2010 (Figure 3-5). It was raised to an approximate height of 20 m. The elevation at the tower is elevation 439 m (1,440'). The met tower clearing is surrounded by regenerating softwood and shrubs.

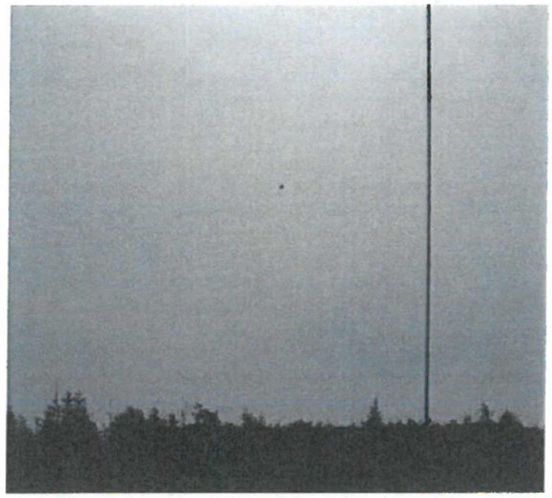

Figure 3-5 Johnson Met Low Detector.

One acoustic bat detector was placed in a dead birch tree on Kingsbury Ridge, located approximately a quarter mile west of Old Mountain Road, on April 15, 2010 (Figure 3-6). The elevation at this site is elevation 540 m (1,772'). The detector was raised to an approximate height of 2.5 m. This tree is located in the middle of an old clearcut where most of the surrounding tree growth is regenerating mixed hardwoods, as well as sapling to pole size spruce and fir.

Figure 3-6 Kingsbury Ridge Tree Detector.

3.2.3 Data Analysis

Ultrasound recordings of bat echolocation may be broken into recordings of a single bat call or recordings of bat call sequences. A call is a single pulse of sound produced by a bat, while a call sequence is a combination of two or more pulses recorded in an Anabat file. Recordings containing less than two calls were eliminated from analysis as has been done in similar studies (Arnett *et al.* 2006). Call sequences typically include a series of calls characteristic of normal flight or prey location ("search phase") and capture periods (feeding "buzzes").

Potential call files were extracted from data files using CFCread© software. The default settings for CFCread© were used during this file extraction process, as these settings are recommended for the calls that are characteristic of bats in the Northeast. This software screens all data recorded by the bat detector and extracts call files using a filter. Using the default settings for this initial screen also ensures comparability between data sets. Settings used by the filter include a max TBC (time between calls) of 5 seconds, a minimum line length of 5 milliseconds, and a smoothing factor of 50. The smoothing factor refers to whether or not adjacent pixels can be connected with a smooth line. The higher the smoothing factor, the less restrictive the filter is and the more noise files and poor quality call sequences are retained within the data set.

Following extraction of call files, each file was visually inspected for species identification and to ensure that only bat calls were included in the data set. Insect activity, wind, and interference can also sometimes produce Anabat files that pass through the initial filter and need to be visually inspected and removed from the data set. Call sequences are easily differentiated from other recordings, which typically form a diffuse band of dots at either a constant frequency or widely varying frequency.

Because bat activity levels are highly variable among individual nights and individual hours (Hayes 1997, Arnett *et al.* 2006), detection rates are summarized on both of these temporal scales. Hourly detection rates were summarized by hour after sunset, as recommended by Kunz *et al.* (2007). Quantitative comparisons among these temporal periods was not attempted because the high amount of variability associated with bat detection would have required much larger sample sizes (Arnett *et al.* 2006, Hayes 1997).

Bat call sequences were individually marked and categorized by species group, or "guild" based on visual comparison to reference calls. Qualitative visual comparison of recorded call sequences of sufficient length to reference libraries of bat calls allows for relatively accurate identification of bat species (O'Farrell *et al.* 1999, O'Farrell and Gannon 1999). Call sequences were classified to species whenever possible, based on criteria developed from review of reference calls collected by Chris Corben, the developer of the Anabat system, as well as other bat researchers. However, due to similarity of call signatures between several species, all classified calls have been categorized into five guilds[4] reflecting the bat community in the region of the Project area and is as follows:

- **Unknown (UNKN)** – All call sequences with less than five calls, or poor quality sequences (those with indistinct call characteristics or background static). These sequences were further identified as either "high frequency unknown" (HFUN) for sequences with a minimum frequency above 30 to 35 kHz, or "low frequency unknown" (LFUN) for sequences with a minimum frequency below 30 to 35 kHz. For this area, HFUN most likely represents eastern red bats, tri-colored bats and *Myotis* species since these species typically produce ultrasound sequences of more than 30 kHz. Big brown, silver-haired and hoary bats would be the species in this area typically producing ultrasound sequences of less than 30 kHz.

- **Myotis (MYSP)** – All bats of the genus *Myotis*. While there are some general characteristics believed to be distinctive for several of the species in this genus, these characteristics do not occur consistently enough for any one species to be relied upon at all times when using Anabat recordings.

- **Eastern red bat/tri-colored bat[5] (RBTB)** – Eastern red bats and tri-colored bats. These two species can produce calls distinctive only to each species. However, significant overlap in the call pulse shape, frequency range, and slope can also occur.

- **Big brown bat/silver-haired bat (BBSH)** – Big brown and silver-haired bats. These species' call signatures commonly overlap and have therefore been included as one guild in this report.

- **Hoary bat (HB)** – Hoary bats. Calls of hoary bats can usually be distinguished from those of big brown and silver-haired bats by minimum frequency extending below 20 kHz or by calls varying widely in minimum frequency across a sequence.

This method of guild identification represents a conservative approach to bat call identification. Since some species sometimes produce calls unique only to that species, all calls were identified to the lowest possible taxonomic level before being grouped into the listed guilds. Tables and figures in the body of this report will reflect those guilds. However, since species-specific identification did occur in some cases, each guild will also be briefly discussed with respect to potential species composition of recorded call sequences.

Once all of the call files were identified and categorized in appropriate guilds, nightly tallies of detected calls were compiled. Mean detection rates (number of recordings/detector-night) for the entire sampling period were calculated for each detector and for all detectors combined.

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[4] Gannon *et al.* 2003 categorized bats into guilds based upon similar minimum frequency and call shape. These guilds were: Unidentified, Myotis, LABO-PISU and EPFU-LANO-LACI. We broke hoary bats out into a separate guild due to the importance of reporting activity patterns of migratory species in the context of wind energy development.

[5] The scientific and common name of the eastern pipistrelle (*Pipistrellus subflavus*) has been changed to the tri-colored bat (*Perimyotis subflavus*).

The sunset time was subtracted from the time of recording in order to determine the number of hours after sunset each file was recorded.

3.2.4 Weather Data

Temperature (degrees Celsius [°C]) and wind speed (meters per second [m/s]) were recorded at 10-minute intervals by the Bessey met tower just South of Route 16 in Mayfield. Wind speed data was collected from a sensor located 59 m above ground level, and temperature data was collected by a sensor located 2.5 m above ground level. The mean, maximum, and minimum temperature and wind speed were calculated for each night. Data through June 1 was available for this report.

3.3 RESULTS

3.3.1 Timing of Activity

Although the 2010 acoustic surveys are continuous, starting in the spring and operating through the fall, results presented here represent the spring migratory period. Deployment end dates for the purposes of this report coincide with biweekly maintenance visits to detectors in early June. The range of dates that each detector was deployed is summarized in Table 3-1.

Table 3-1. Summary of bat detector field survey effort and results during Spring 2010 at the Bingham Wind Project.

Location	Dates Deployed	Calendar Nights	Detector-Nights*	Recorded Sequences	Detection Rate **	Maximum Sequences recorded ***
Bessey Met High	4/13 - 6/8	57	57	10	0.2	2
Bessey Met Low	4/13 - 6/8	57	57	18	0.3	4
Bigelow Ridge Tree	4/14 - 6/2	50	50	89	1.8	18
Crockett Met High	4/14 - 6/8	56	56	8	0.1	2
Crockett Met Low	4/14 - 6/8	56	56	15	0.3	2
Johnson Met Low	4/14 - 6/2	50	50	17	0.3	5
Johnson Met Tree	4/14 - 6/2	50	50	61	1.2	4
Kingsbury Ridge Tree	4/15 - 6/2	49	49	32	0.7	32
Overall Results		***425***	***425***	***250***	***0.6***	--

* 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.

A total of 250 call sequences were recorded during the spring survey (Table 3-1). Activity increased with decreasing detector height. Detectors deployed above tree canopy in met towers ("Met High" detectors) had a combined detection rate of 0.16 call files recorded per detector night (18 files recorded by 2 detectors over 113 detector-nights). Detectors deployed at tree canopy height in met towers ("Met Low" detectors) had a combined detection rate of 0.31 call files recorded per detector night (50 files recorded by 3 detectors over 163 detector-nights). Detectors deployed at or below tree canopy height had a combined detection rate of 1.20 call sequences per detector night (182 files recorded by 3 detectors over 149 detector-nights). Activity increased over time during the spring survey period (Figure 3-7). Activity was first recorded on April 20, but was not recorded consistently (on more than two nights in a row) until April 28. The maximum activity recorded in a single night by all detectors occurred on May 28 (27 calls for all detectors combined) (Figure 3-7).

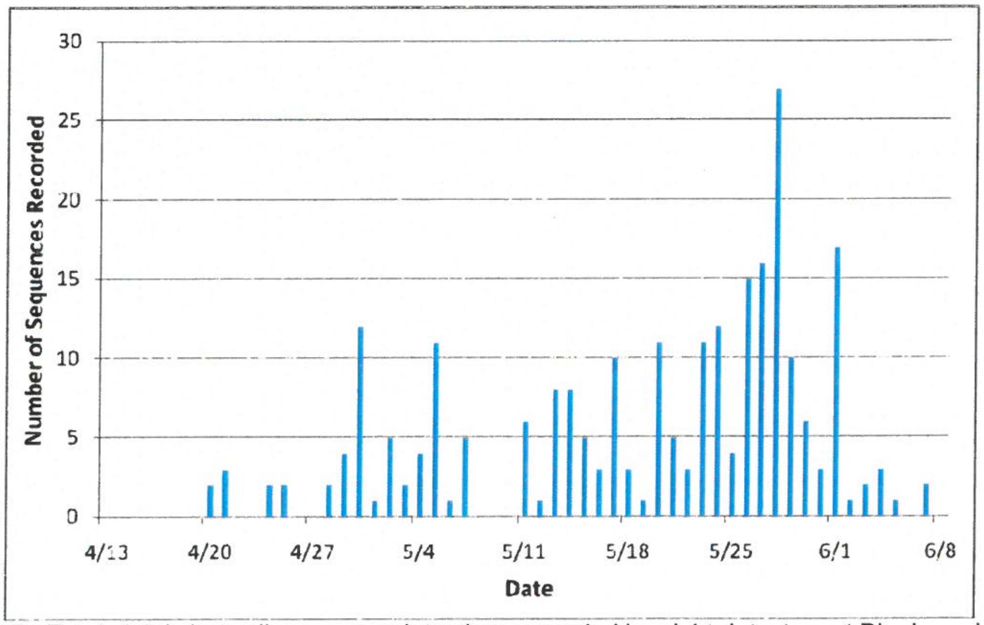


Figure 3-7. Total nightly bat call sequence detections recorded by eight detectors at Bingham, between mid-April and early June 2010.

There was a sharp spike in activity 3 hours after sunset at tree detectors (Figure 3-8). Trends were less clear at Met High and Met Low detectors due to low recorded activity rates. However, there were two slight peaks evident at 1 hour and 4 hours after sunset at Met Low detectors, and at 1 hour and 6 hours after sunset at Met High detectors (Figure 3-8).

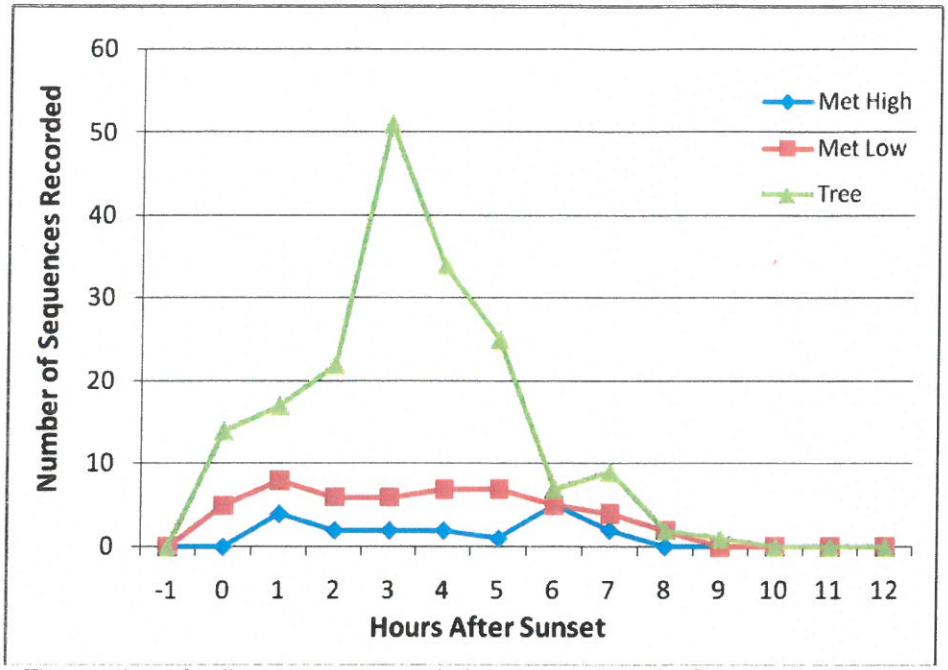


Figure 3-8. The number of call sequences recorded during each hour of the night at Met High, Met Low, and Tree detectors during Spring 2010 at the Bingham Wind Project.

3.3.2 Species Composition

The largest proportion of calls was assigned to the unknown (UNKN) guild (Table 3-2). The *Myotis* guild (MYSP) contained the highest number of call sequences (n = 92) identified to a taxonomic level. At or below tree canopy level detectors combined recorded calls from all five guilds, while met tower detectors recorded call sequences from all guilds except the red bat/tri-colored bat (RBTB) guild (Table 3-2).

Table 3-2. Distribution of detections by guild during Spring 2010 at the Bingham Wind Project.

Detector	Guild					Total
	BBSH	HB	MYSP	RBTB	UNKN	
Bessey Met High	4	0	5	0	1	10
Bessey Met Low	3	3	1	0	11	18
Bigelow Ridge Tree	3	0	41	0	45	89
Crockett Met High	1	0	1	0	6	8
Crockett Met Low	2	2	5	0	6	15
Johnson Met Low	4	2	3	0	8	17
Johnson Met Tree	12	4	23	1	21	61
Kingsbury Ridge Tree	0	0	13	0	19	32
Total	**29**	**11**	**92**	**1**	**117**	**250**
Total Guild Composition %	**11.6%**	**4.4%**	**36.8%**	**0.4%**	**46.8%**	
Met Total	**14**	**7**	**15**	**0**	**32**	**68**
Met Guild Composition %	**20.6%**	**10.3%**	**22.1%**	**0.0%**	**47.1%**	
Tree Total	**15**	**4**	**77**	**1**	**85**	**182**
Tree Guild Composition %	**8.2%**	**2.2%**	**42.3%**	**0.5%**	**46.7%**	

Appendix B provides a series of tables with more specific information on the nightly timing, number, and species composition of recorded bat call sequences. Specifically, Appendix B Tables 1 through 8 provide information on the number of call sequences, by guild and suspected species, recorded at each detector and the weather conditions for that night. Analook files for all 250 recorded call sequences can be made available upon request.

3.3.3 Activity and Weather

Weather data from April 15 through June 1 was available for this report. Mean nightly wind speeds in the Project area varied between 2.09 and 11.67 m/s (Figure 3-9), and mean nightly temperatures varied between $^{-}$0.6 °C and 26.1 °C (Figure 3-10). Although activity was highly variable over the course of the survey, there were weak associations between the number of call sequences recorded and the weather conditions on that night. Activity was highest when mean nightly wind speeds were between 6 and 8 m/s (Figure 3-9), and increased as temperature increased (Figure 3-10). On May 28, when the maximum number of call sequences was recorded in a single night, the mean nightly wind speed was 6 m/s and the mean nightly temperature was 16 °C.

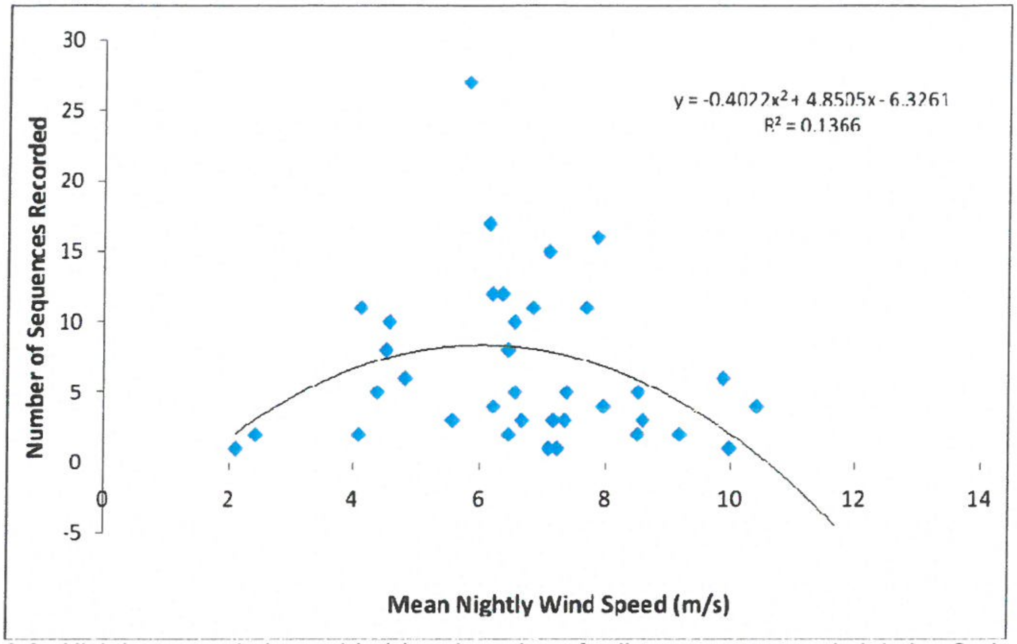


Figure 3-9. Nightly mean wind speed (m/s) and number of call sequences recorded during Spring 2010 at the Bingham Wind Project.

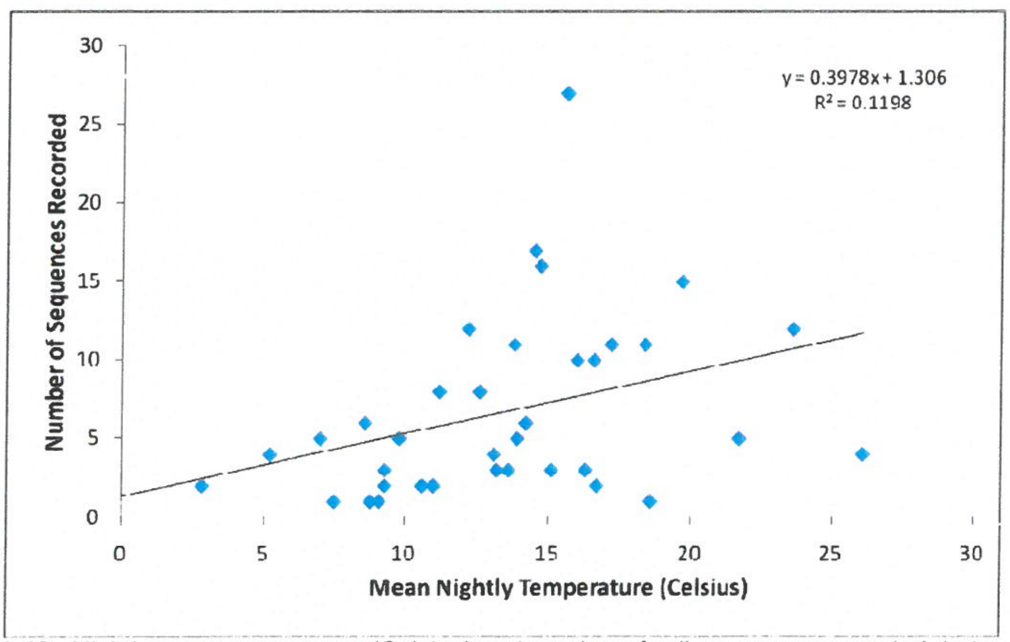


Figure 3-10. Nightly mean temperature (Celsius) and number of call sequences recorded during Spring 2010 at the Bingham Wind Project.

3.4 DISCUSSION

The 2010 acoustic survey was initiated in the spring and the detectors will continue to operate through the fall. The results of the summer and fall acoustic surveys will be presented in a separate report following completion of the surveys. The data included in this report are representative of trends often observed during spring acoustic surveys, and during the spring migratory period. Overall activity was low throughout the survey, with detection rates at individual detectors ranging from 0.1 to 1.8 call sequences recorded per detector-night. Activity increased over time, likely due to a corresponding increase in mean nightly temperatures across the spring season, as well as an increase in the local bat population as individuals arrived for the summer maternity season. Activity was higher at the three tree detectors (1.2 sequences/detector-night) than five met detectors (0.2 sequences/detector-night), and species composition varied between the two detector types, with *Myotis* species more prominently recorded at tree detectors and guilds containing long-distance migrant species (BBSH and HB guilds) more prominently recorded at the met detectors.

These data are similar to trends observed at other proposed wind facilities. Pre- and post-construction acoustic monitoring of bat activity has documented a negative relationship with average nightly wind speed (Fiedler 2004, Reynolds 2006). Reynolds (2006) found activity of bats to be highest on nights with wind speeds of < 5.4 m/s during the spring migratory period at the Maple Ridge, New York wind facility. Bat activity levels at Buffalo Mountain, Tennessee also showed a negative association with average nightly wind speeds (Fiedler 2004). At Bingham, peak activity occurred on a night when mean wind speeds were 5.8 m/s.

Pre- and post-construction acoustic surveys at wind facilities have also documented bat activity to be positively correlated with nightly mean temperatures (Fiedler 2004, Reynolds 2006). Reynolds (2006) found that no detectable spring migratory activity occurred on nights when the mean temperature was below 10.5°C (50.9°F). Bat activity at Buffalo Mountain, West Virginia from 2000 to 2003 was most closely correlated with average nightly temperature (Fiedler 2004). Although some activity at Bingham did occur on cold nights, peak activity occurred on nights with temperatures above 10°C.

Bat calls were identified to guild within this report, although calls were provisionally categorized by species when possible during analysis. Tree detectors recorded more *Myotis* activity (42%) than met detectors (22%). Since bats belonging to this guild are resident species that forage primarily at or below tree canopy height it would be expected that they would most often be recorded by tree detectors. Only one call sequence was assigned to the RBTB guild, although poor-quality calls from these two species are likely included in low numbers in the Unknown guild. Twelve percent of calls were of the BBSH guild, with the most recorded at the Johnson Met Tree detector. Hoary bat calls only made up 4 percent of all calls recorded, and were identified at all three Met low detectors, as well as the Johnson Met Tree detector. Of the 250 total sequences recorded, 47 percent were classified as UNKN due to their short duration or poor quality.

When considering the level of activity documented at Bingham, it is important to acknowledge that numbers of recorded bat call sequences cannot be correlated with the number of bats in an area because acoustic detectors do not allow for differentiation between individuals (Hayes 2000). Thus, results of acoustic surveys must be interpreted with caution. Methods surrounding acoustic bat surveys are continually evolving, and there is currently little data aiding in the interpretation of the number of calls per detector nights. Results cannot be used to determine the number of bats inhabiting an area or quantitatively determine a post-construction fatality rate. Although interpretations are limited, the surveys represent a sample of activity and the general species groups that occur in the Project area.

4.0 Diurnal Raptor Surveys

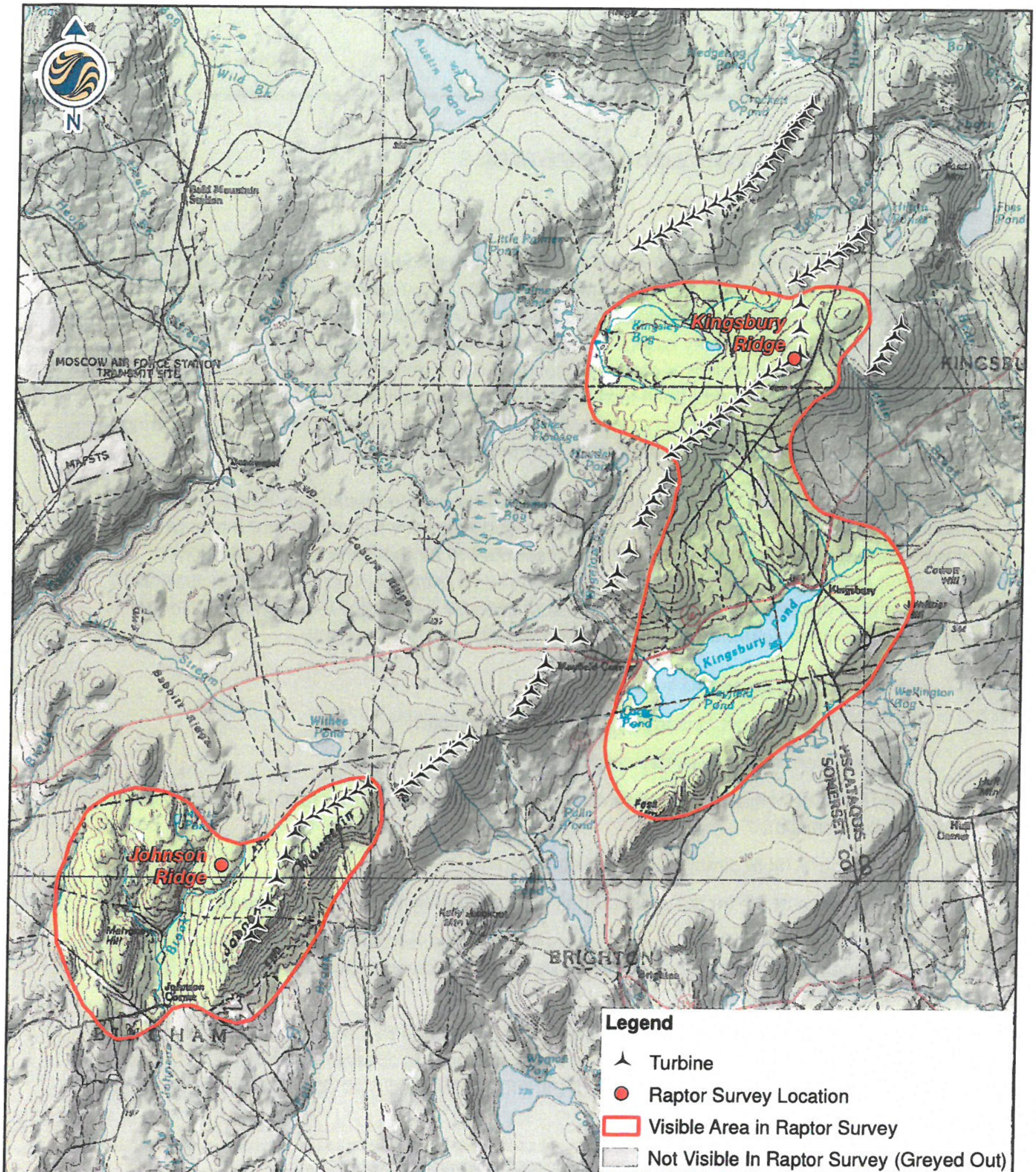
4.1 INTRODUCTION

Spring 2010 raptor surveys were conducted at the Project consistent with methods and level of effort at pre-construction surveys at other proposed wind energy Project's in the state. The purpose of the raptor surveys were to sample migration activity at central and prominent locations within the Project area, to document the species that occur in the vicinity of the Project, with particular effort focused on documenting bald eagle activity. It was also the purpose of the study to record the approximate flight heights, flight path locations, and other flight behaviors of all raptor species observed. The results of the surveys provide baseline species composition and behavioral data for migrants and seasonally local raptors which occur in the area.

4.1.1 Study Area Description

Two observation locations, one on Kingsbury Ridge and one on Johnson Ridge, were used during the spring 2010 surveys (Figure 4-1). The Kingsbury Ridge observation site was located approximately a quarter mile west of Old Mountain Road in Kingsbury. The observation location was in an old clear cut. The site provided a good view to the south over Kingsbury and Mayfield Ponds and west over the valley. Due to the topography and surrounding trees, the views in other directions were limited to the airspace above the surrounding trees. The Johnson Ridge observation site was located approximately 0.75 miles west of the Johnson Ridge met tower. This site was located along a dirt road surrounded by a spruce plantation and a recent clearcut. From this site, the met tower located on Johnson Ridge could clearly be seen as well as the profile of the Johnson ridgeline. There also were decent views of the valleys and surrounding landscape to the south, southwest west, and northwest. Crockett ridge was not in view from either survey location.

For the purposes of this report, the 'study area' is considered the observable airspace above the surrounding topography as seen from these observation locations (Figure 4-1). The 'Project area' includes only those locations within the study area where turbines are proposed. The Project area includes three separate ridgelines: Johnson Ridge, Kingsbury Ridge (north and south of Route 16), and Crockett Ridge.



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Stantec Consulting Services Inc.
30 Park Drive
Topsham, ME USA
04086
Phone (207) 729-1199
Fax: (207) 729-2715
www.stantec.com

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Client/Project
Bingham Wind Project
Bingham, Maine

Figure No.
4-1

Title
Raptor Survey Study Area and Viewshed Map

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4.2 RAPTOR DATA COLLECTION METHODS

4.2.1 Field Surveys

Surveys in spring 2010 were performed on 10 days during the spring migration period; on five of these days, surveys were performed simultaneously by two observers, yielding a total of 15 total survey days. The level of effort included 5 simultaneous days of survey from two observation locations, yielding 10 total survey days. The spring 2010 raptor surveys utilized standard methodologies to monitor diurnal raptor migration activity. Raptor migration surveys methods were based on methods used by the Hawk Migration Association of North America (HMANA 2007). Surveys were conducted for seven consecutive hours between 9 am and 4 pm, during the peak hours of thermal development and raptor movement.

During surveys the observer scanned the sky and surrounding landscape by eye or with binoculars. Each raptor observation, or pass, was documented. Each time a bird was observed it was recorded, regardless of whether it was suspected to be a local bird that had been observed at some other point during the survey day. Therefore, daily count totals include all observations, or passes, of birds observed throughout a survey day[6]. Detailed information for each observation was recorded on standardized data sheets, including:

- Observation date and time;
- Species[7], number of individuals, and age (if possible);
- The location of each bird depicted on a topographical map;
- The flight height[8] and behaviors observed in each of the topographical positions where birds occurred[9];
- The general flight direction of each bird; and
- An estimate of the length of time birds spent below maximum turbine height.

Additionally, observations of non-raptor species including passerines and water birds were often documented and recorded by the observer as incidentals; however, this data was not collected uniformly or systematically.

Topographical flight positions were summarized into categories that describe the landscape surrounding the observation site (these positions apply to birds observed both within as well as outside of the Project area): A1) parallel to ridge, A2) perpendicular to ridge, A3) over saddle, B)

[6] It should be noted that HMANA observers typically do not count birds suspected to be local or seen previously that day; therefore, this should be considered when comparing results between datasets.

[7] Birds that flew too rapidly or were too far to accurately identify were recorded as unidentified to their genus or, if the identification of genus was not possible, unidentified raptor.

[8] Nearby objects with known heights, such as met towers, and trees, were used to estimate flight height.

[9] As individual birds traveled through or in the vicinity of the Project, all topographical position categories in which a bird occurred were recorded.

flight path over upper slope of ridge, C) flight path over lower slope of ridge, and D) flight path over a valley (see Figure 4-2 below). As individual birds traveled through or in the vicinity of the Project, all position categories in which a bird occurred were recorded.

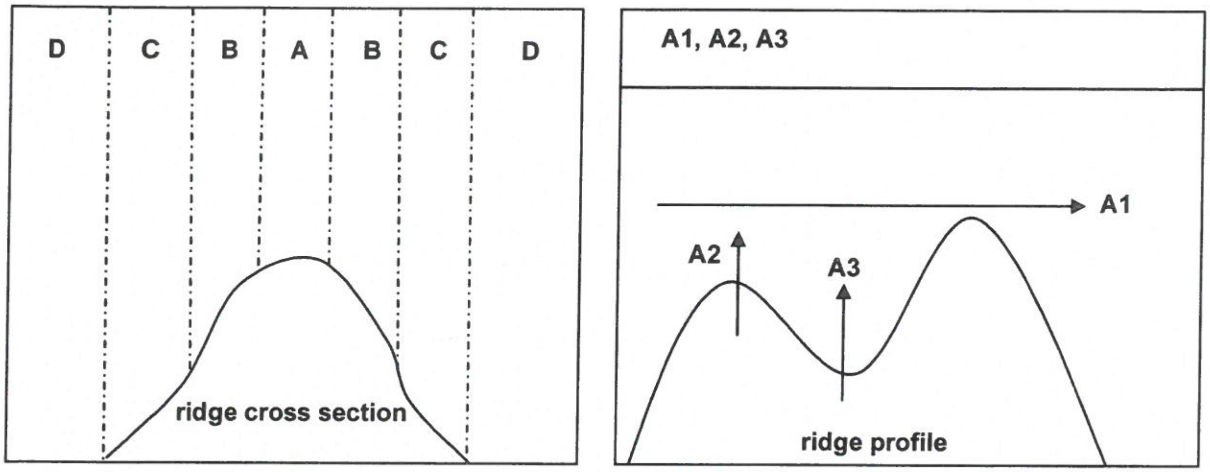


Figure 4-2. Raptor flight position categories in relation to the topography of the study area (codes apply to locations within and outside of Project area). A1) parallel to ridge, A2) perpendicular to ridge, A3) over saddle, B) flight path over upper slope of ridge, C) flight path over lower slope of ridge, and D) flight path over a valley.

4.2.2 Weather Data

Wind direction, wind speed, and the development of thermals largely influence raptor flight behaviors and flight paths. Therefore, throughout each survey day, the observer recorded hourly weather conditions including wind speed and direction, temperature, sky condition, percent cloud cover, cloud type, and relative cloud height.

Specific seasonal weather conditions influence raptor migration movements. Atmospheric instability and updrafts are conditions that accompany low pressure systems and storms and raptors will move in advance of these conditions (Drennan 1981). Additionally, soaring on southerly winds is more efficient for northbound migrants (Drennan 1981). Raptor migration in the spring is most intense during the approach of a low pressure system and a cold front, and on days with southerly winds and rising air temperatures (Drennan 1981). In order to consider the atmospheric influences on raptor activity during the days that were sampled in spring 2010, regional surface weather map images were interpreted to determine the dates that daytime pressure systems (high, low, or none) moved through the region. Surface weather maps, prepared by the National Centers for Environmental Prediction, the Hydro-meteorological Prediction Center, and the National Weather Service, were downloaded daily for the majority of the survey window. The Surface Weather Maps show station data and the analysis for 7:00 am, EST.

4.2.3 Raptor Data Analysis Methods

Raptor observation data were summarized by survey day and for the entire survey period. As there were two observation locations, data was analyzed separately (where applicable) for each observation location. Data analysis included a summary of:

- Daily and seasonal observation rates (raptors observed per hour);
- Total observations of the different species observed;
- Hourly observation totals;
- The percentage of birds observed in the study area which occurred specifically within the Project area;
- The percentage of birds suspected to be actively migrating;
- A summary of flight behaviors observed in the topographical positions of the different locations of the study area;
- The average minimum flight height of birds within each topographical position category; and
- For those birds observed within proposed turbine areas (topographical positions A and B only), the percentage of birds seen below 152 m (499').

The results of the spring 2010 surveys were compared to the results of the closest available HMANA raptor migration surveys conducted in the region. HMANA results are available from the following sites: Bradbury Mountain, Pownal, ME; Barre Falls, Barre, MA; Pitcher Mountain, Stoddard, NH; Pilgrim Heights, North Truro, MA; Plum Island, Newburyport, MA.

4.3 RESULTS

The spring surveys were conducted on 10 days from mid-March (March 19) through late-May (May 21). Surveys were conducted simultaneously from the two observation locations on five of those survey days (April 30, May 5, May 13, May 18, and May 21), yielding a total of 15 survey days (5 days at Johnson Ridge and 10 days at Kingsbury Ridge). A total of 105 hours were surveyed (70 hours at Kingsbury Ridge and 35 hours at Johnson Ridge). Table 4-1 summarizes the spring 2010 survey effort and results.

Table 4-1. A summary of the spring 2010 survey effort and results at two observation locations at the Bingham Wind Project

Range of survey dates	**3/19/2010-5/21/2010**
No. survey days	**10 (10 at Kingsbury Ridge, 5 simultaneous at Johnson Ridge)**
No. survey hours	**105 (70 at Kingsbury Ridge, 35 at Johnson Ridge)**
No. raptor species observed	**9**
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*
osprey	*Pandion haliaetus*
red-tailed hawk	*Buteo jamaicensis*
sharp-shinned hawk	*Accipiter striatus*
turkey vulture	*Cathartes aura*
unknown raptor	*n/a*
Total no. observations of raptors	**56 (19 at Kingsbury Ridge, 37 at Johnson Ridge - 2 simultaneous)**
Seasonal passage rate (raptor observations/hour)	**Kingsbury Ridge: 0.27; Johnson Ridge: 1.06**
Total no. observations of raptors within Project area (percent of total observations)	**Kingsbury Ridge: 13 (68%); Johnson Ridge: 21 (57%)**
Total no. of observations of raptors in the Project area and below max rotor height (percent of total observations)	**Kingsbury Ridge: 10 (77%); Johnson Ridge: 20 (95%)**

4.3.1 Weather Summary

Among survey days, the average hourly temperature was 14° C (58° F). Temperatures ranged from 4° C to 27° C (40 to 80° F). Sky conditions were generally clear to partly cloudy. Wind direction was generally from the northwest, north and west. Observers recorded wind speed codes of 3 (9-12 mph) or below on 6 of the 10 survey days (Table 4-2).

Analysis of regional surface weather maps indicated the timing of approaching low pressure systems, when raptor movements tend to be accentuated. Table 4-2 shows the wind direction and pressure system pattern on each survey date during the spring surveys.

Table 4-2. Wind direction and pressure systems during spring 2010 surveys			
Date	**Wind direction**	**Wind speed code (s)**	**Daytime Pressure System (high or low)**
		1 = 1-3 mph; **2** = 4-7 mph; **3** = 9-12 mph; **4** = 13-18 mph; **5** = 19-24 mph	
3/19/2010	SE	1, 2, 3	not available
3/25/2010	W	1	low 2 days before survey date
4/2/2010	SW	3, 4, 5	low then high 2 days before survey date
4/15/2010	NW	3, 4	high pressure 1 day before, low on survey date
4/20/2010	NW	4, 5	survey date one day before low system moved in for a few days
4/30/2010	NW	5	survey date one day before low system moved in for a few days
5/5/2010	WNW	2	low starting 3 days before survey date
5/13/2010	NW	2	low one day before survey date
5/18/2010	SW	1	survey date one day before low system moved in for a few days
5/21/2010	NW	1	low 2 days before survey date

4.3.2 Raptor Data

Over the course of the survey period a total of 56 observations of raptors were made from both observation locations combined (19 observations from Kingsbury and 37 observations from Johnson). Based upon timing, flight direction and flight paths, two of these observations (1 turkey vulture on May 5, and 2 turkey vultures on May 21) were thought to be simultaneous observations between the observers at Kingsbury and Johnson Ridges. The seasonal passage rate for Kingsbury Ridge was 0.27 raptor observations per hour (raptors/hr); the seasonal passage rate for Johnson Ridge was 1.06 raptors/hr. Figure 4-3a and b and Appendix C Tables 1a and b show the daily totals of raptor species for the spring season at the two observation sites.

At Kingsbury Ridge, daily passage rates ranged from 0.0 raptors/hr (March 19, April 15, 20, and 30) to 0.57 raptors/hr (April 2 and May 5). Daily passage rates at Johnson Ridge ranged from 0.29 raptors/hr (April 30) to 2.0 (May 13) raptors/hr. The day with the highest passage rate at either site, May 13 at Johnson Ridge, was characterized by moderate northwest winds and a low pressure system which had passed through the region the day before. May 5 also experienced a relatively high raptor passage rate, particularly at Johnson Ridge (1.14 raptors/hr). This survey day was characterized by moderate west-northwest winds and a low pressure system which had settled into the region three days prior to the survey date.

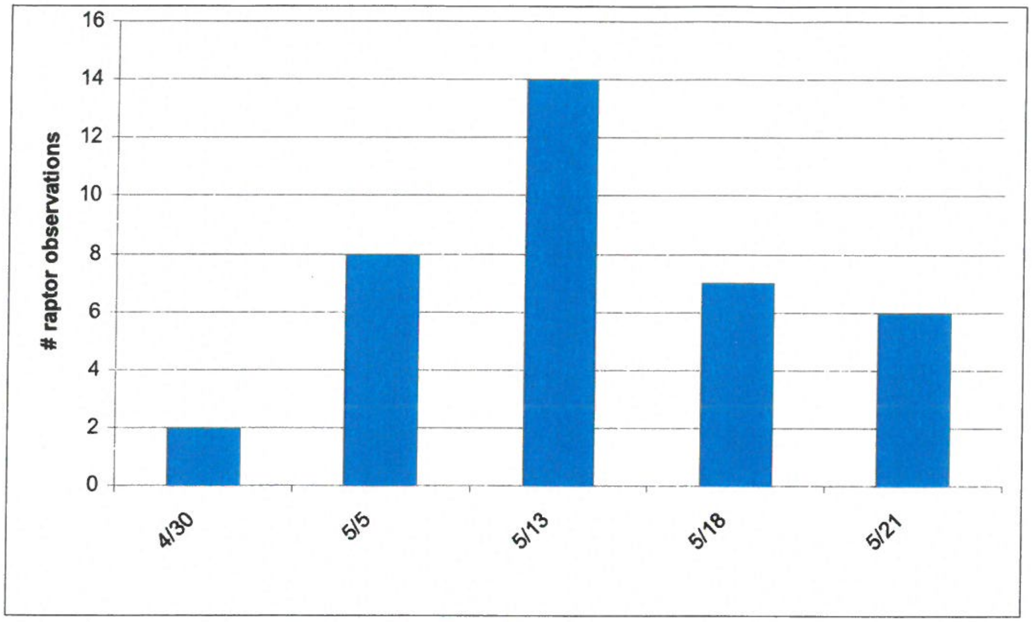


Figure 4-3a. Survey day totals of raptor observations from Johnson Ridge during Spring 2010 surveys at the Bingham Wind Project.

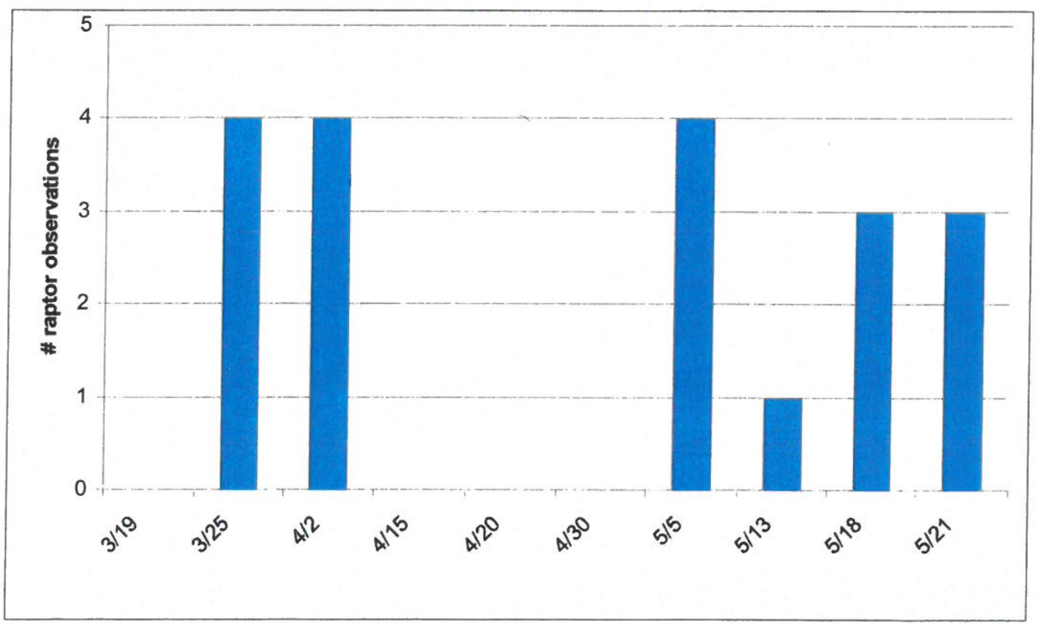


Figure 4-3b. Survey day totals of raptor observations from Kingsbury Ridge during Spring 2010 surveys at the Bingham Wind Project.

There were nine species of raptors observed (not including one unidentified raptor) at both observation locations combined (Figures 4-4a and b, Appendix C Table 1a and b).

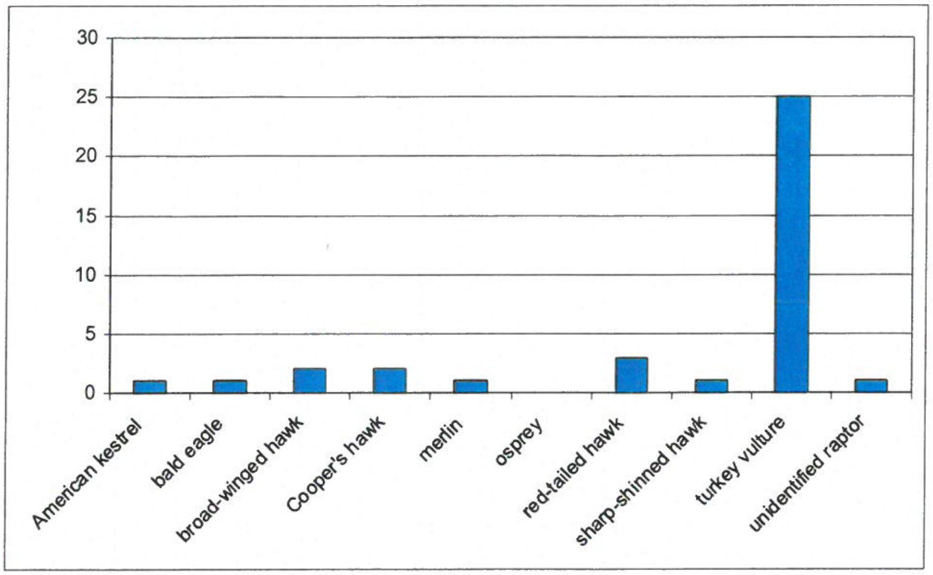


Figure 4-4a. Number of observations of raptor species observed from Johnson Ridge during Spring 2010 surveys at the Bingham Wind Project.

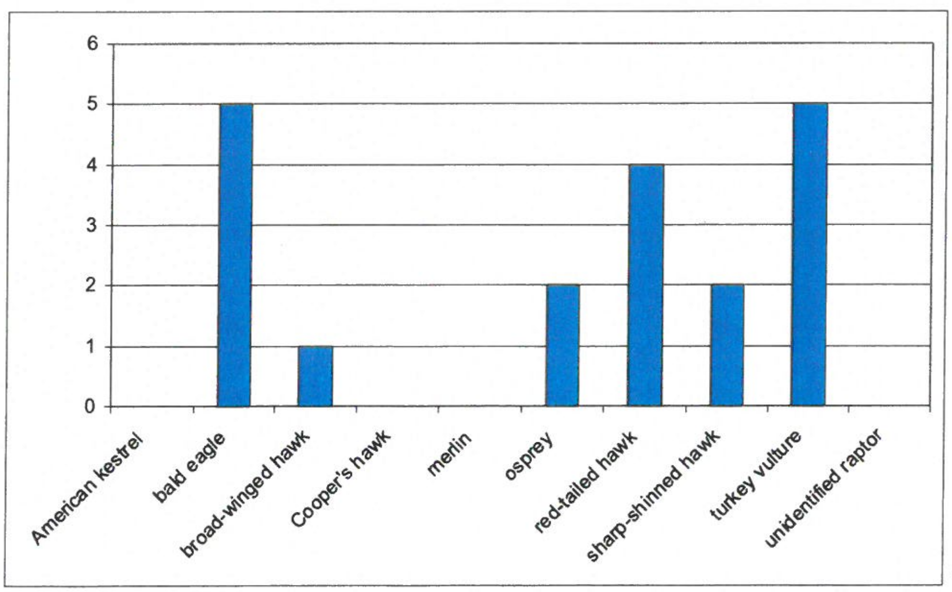


Figure 4-4b. Number of observations of raptor species observed from Kingsbury Ridge during Spring 2010 surveys at the Bingham Wind Project.

At Johnson Ridge, turkey vultures were the most commonly observed species (n=25, 68%), followed by red-tailed hawk (n=3, 8%). At Kingsbury Ridge, bald eagle (n=5, 26%) and turkey vulture (n=5, 26%) were the most commonly observed species followed by red-tailed hawk (n=4, 21%). Four of the five bald eagle observations were made on March 25, 2010. Based on the time between observations it is likely that one adult eagle was counted twice.

4.3.3 Hourly observations

Throughout the survey season, at both observation sites the majority of observations peaked between 10 and 11 am. At Johnson Ridge a second peak occurred between noon and 1 pm, while a second peak occurred between 2 and 3 pm at Kingsbury Ridge (Figure 4-5a and b, Appendix C Table 2).

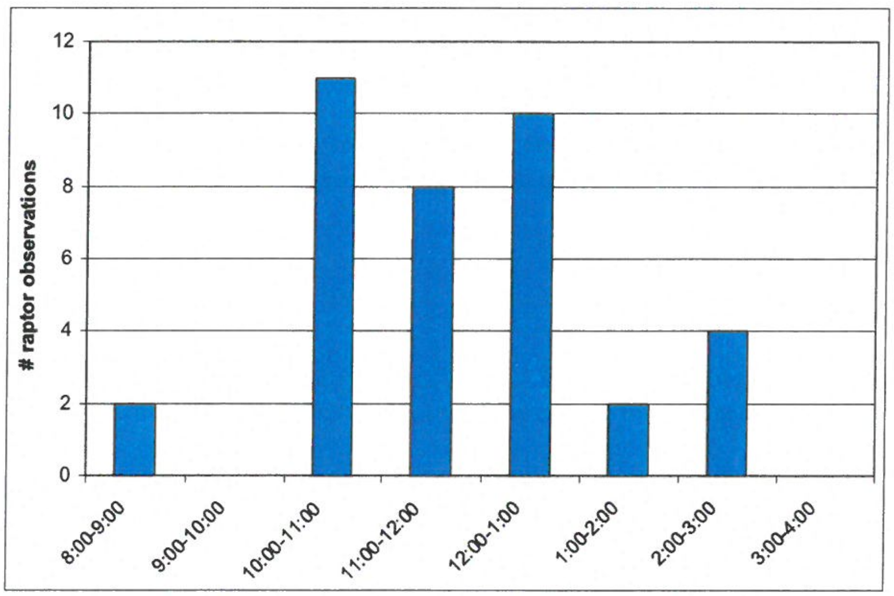


Figure 4-5a. Number of observations of raptors per survey hour from Johnson Ridge during Spring 2010 surveys at the Bingham Wind Project.

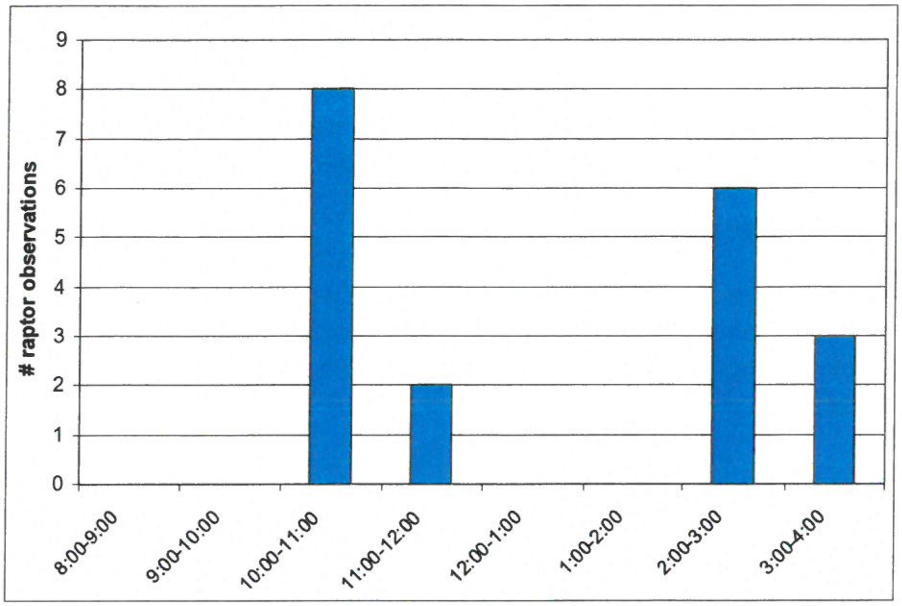


Figure 4-5b. Number of observations of raptors per survey hour from Kingsbury Ridge during Spring 2010 surveys at the Bingham Wind Project.

4.3.4 Raptor Locations

Of the 56 total raptor observations made within the study area at both observation locations combined, 34 (61%) observations occurred within the Project area (Figure 4-6, Appendix C Table 3). Specifically, 21 raptor observations occurred over Johnson Ridge and 13 observations occurred over Kingsbury Ridge. All other observations occurred either over hills, peaks, or valleys outside of the Project area.

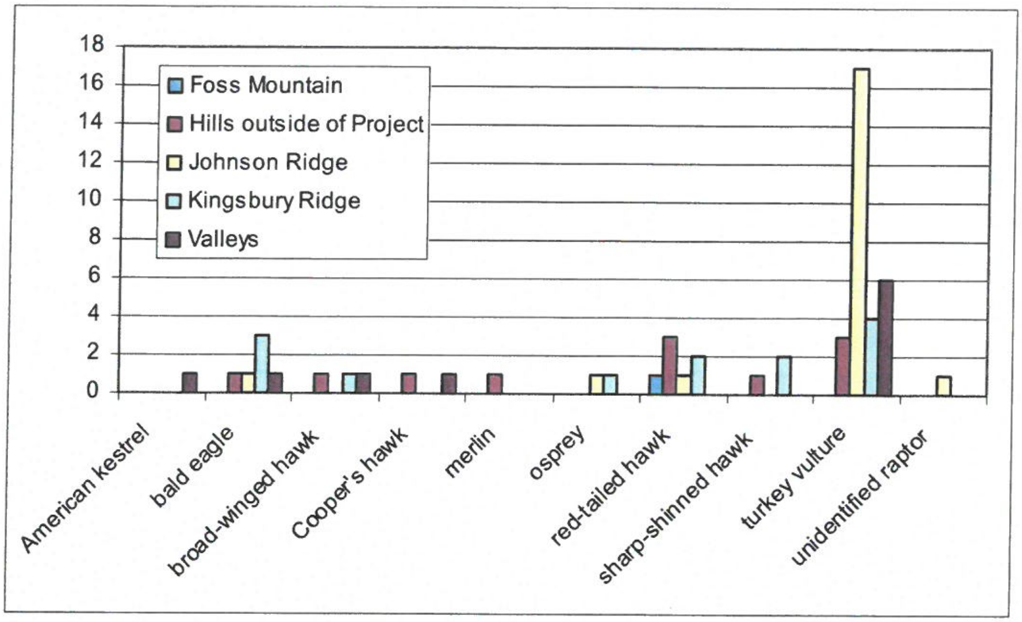
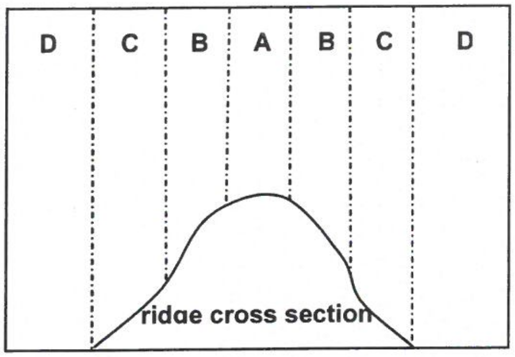


Figure 4-6. Number of observations of raptors within different study area locations observed from Johnson and Kingsbury Ridges combined during Spring 2010 surveys at the Bingham Wind Project.

4.3.5 Raptor Behaviors

Raptor behaviors observed in the topographical positions of the study area locations are summarized in Table 4-3. Note that there are more behavior observations than there were total raptors observed because some raptors exhibited multiple behaviors while passing through multiple topographical positions in the vicinity of the study area.



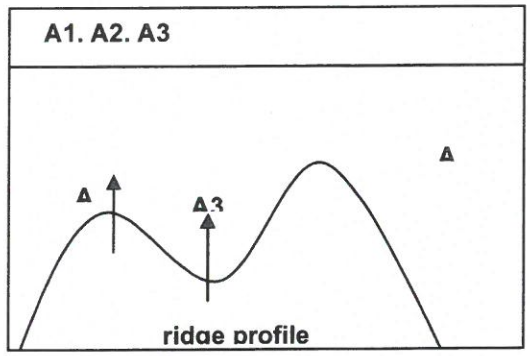


Table 4-3. Raptor behaviors summarized by location in study area and flight position as seen from Johnson and Kingsbury Ridge combined, Bingham Wind Project, Spring 2010

Location in Study Area	soaring, gliding						powered flight						foraging behaviors						territorial or courtship behavior						perched					
	A1	A2	A3	B	C	D	A1	A2	A3	B	C	D	A1	A2	A3	B	C	D	A1	A2	A3	B	C	D	A1	A2	A3	B	C	D
Foss Mountain	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Hills outside of Project	2	3	0	6	4	2	0	2	0	2	1	0	0	0	0	0	3	1	0	0	0	2	2	0	0	0	0	0	1	0
Johnson Ridge	13	4	0	4	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Kingsbury Ridge	9	1	0	6	3	2	1	1	0	5	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Valleys	0	0	0	0	0	9	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total behaviors observed at both observation sites combined = 98																														

Within visible Project area locations (Johnson and Kingsbury Ridges), the majority of birds observed were soaring or gliding over the upper slopes of the ridges, or parallel to the ridges (Table 4-3). There were no territorial or courtship behaviors or perched birds observed within areas of the Project; however, one bird (a red-tailed hawk) demonstrated foraging behaviors within the Project area as it was seen hovering over a lower slope of Johnson Ridge.

Based on their flight behaviors, raptors suspected to be actively migrating or not actively migrating are summarized in Table 4-4a and b. Raptors were considered actively migrating if their flight path was generally direct and in a northerly direction. Raptors would be characterized as stop-over or seasonally local birds if they were traveling in a non-direct manner and in a non-migratory direction, or if they exhibited perched or foraging flight behaviors. At Johnson Ridge, 8 percent (n=3) were suspected to be actively migrating. At Kingsbury Ridge, 32 percent (n=6) were suspected to be actively migrating. All turkey vultures, the most commonly observed raptor during the surveys, were believed to be seasonally local birds.

Table 4-4a. Observations of raptors suspected to be actively migrating at Johnson Ridge, Bingham Wind Project, Spring 2010

Species	Not Actively Migrating	Actively Migrating	Total
American kestrel	1		1
bald eagle	1		1
broad-winged hawk	2		2
Cooper's hawk		2	2
merlin		1	1
osprey			
red-tailed hawk	3		3
sharp-shinned hawk	1		1
turkey vulture	25		25
unidentified raptor	1		1
Total	**34**	**3**	**37**

Table 4-4b. Observations of raptors suspected to be actively migrating at Kingsbury Ridge, Bingham Wind Project, Spring 2010

Species	Not Actively Migrating	Actively Migrating	Unknown	Total
American kestrel				
bald eagle		1	4	5
broad-winged hawk	1			1
Cooper's hawk				
merlin				
osprey		2		2
red-tailed hawk	2	2		4
sharp-shinned hawk	1	1		2
turkey vulture	5			5
unidentified raptor				
Total	**9**	**6**	**4**	**19**

4.3.6 Flight Heights

The average minimum flight heights of birds observed in the different topographical positions of the study area are summarized in Table 4-5a and b below. These summaries include birds observed both within and outside of the Project area.

Table 4-5a. Number of observations and average flight heights for each position category for birds observed from Johnson Ridge, Bingham Wind Project, Spring 2010

	A1) flight along or parallel to ridge	A2) crossed ridge	A3) flight crossed depression or saddle	B) upper slope	C) lower slope	D) over valley
No. of position observations (n=49)	14	7	0	12	7	9
Average minimum flight height (m)	70	107	N/A	74	104	67

Table 4-5b. Number of observations and average flight heights for each position category for birds observed from Kingsbury Ridge, Bingham Wind Project, Spring 2010

	A1) flight along or parallel to ridge	A2) crossed ridge	A3) flight crossed depression or saddle	B) upper slope	C) lower slope	D) over valley
No. of position observations (n=38)	11	1	0	12	6	8
Average minimum flight height (m)	111	30	N/A	141	170	225

At Johnson Ridge, 21 observations (57%) occurred within the Project area in topographical positions on ridgelines where the proposed turbines are to be sited (positions A, B, and C). Of these birds, 20 (95%) occurred at flight heights below the proposed maximum rotor height of 152 m (Figure 4-7a, Appendix C Table 4a). At Kingsbury Ridge, 13 observations (68%) occurred within the Project area in positions on ridgelines where the proposed turbines are to be sited. Of these, 10 observations (77% of the 13 in the Project area) occurred at flight heights below the proposed maximum rotor height (Figure 4-7b, Appendix C Table 4b).

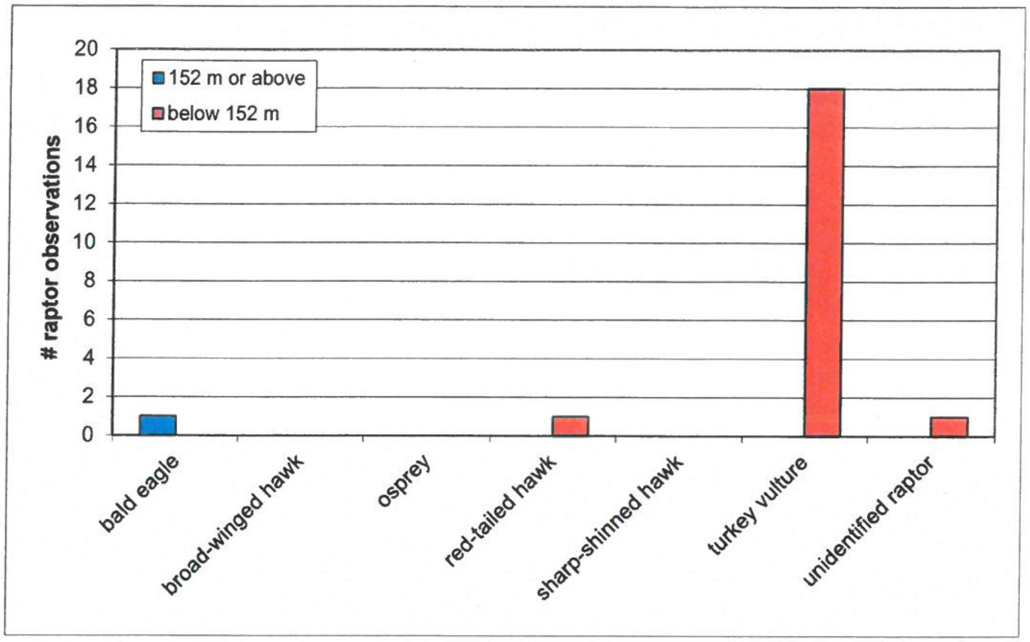


Figure 4-7a. Number of observations of raptor species observed within proposed turbine areas (positions A, B, C within Project area) at heights above and below 152 m from Johnson Ridge during Spring 2010 surveys at the Bingham Wind Project.

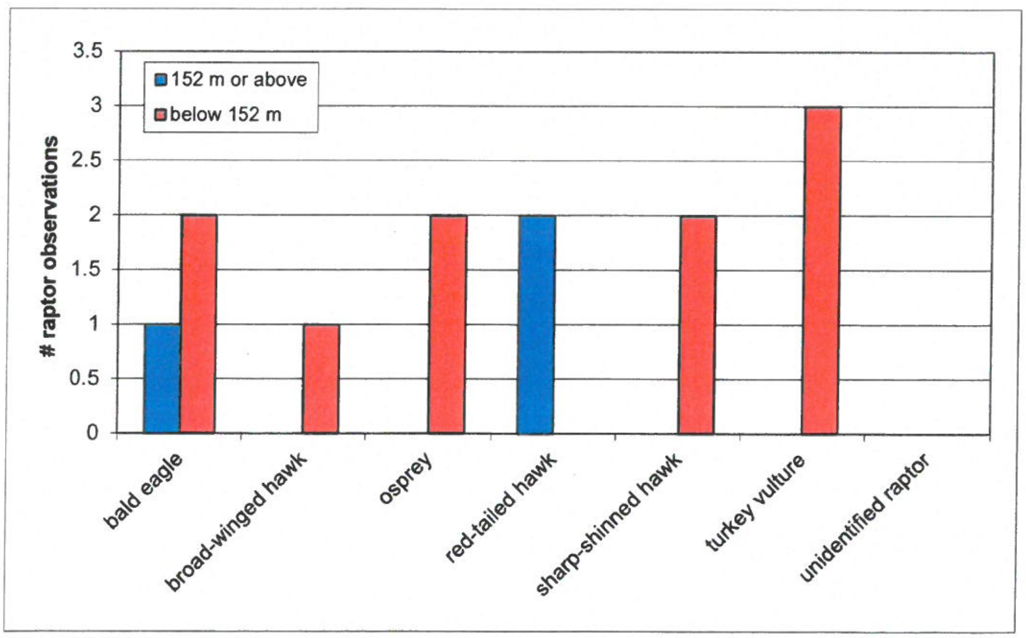


Figure 4-7b. Number of observations of raptor species observed within proposed turbine areas (positions A, B, C within Project area) at heights above and below 152 m from Kingsbury Ridge during Spring 2010 surveys at the Bingham Wind Project.

4.3.7 Rare, Threatened and Endangered Species

No state or federally-listed endangered or threatened raptor species were observed during spring 2010 surveys. One state-listed species of special concern, bald eagle, was observed.

Six observations of bald eagles occurred in the study area, four of which were within the Project area. Two adult bald eagles crossed Kingsbury Ridge on March 25 at heights equal to and above 152 m. An observation of an adult was made on March 25; the bird was seen over a valley outside of the Project area. An observation of a sub-adult was made on March 25; it flew at 50 to 100 m as it crossed Kingsbury Ridge. A sub-adult bald eagle was observed on May 5 outside of the Project area. A third sub-adult observation was made on May 21 flying at over 500 m over Johnson Ridge.

4.3.8 Incidental Non-raptor Observations

There were 38 non-raptor avian species observed incidentally to the spring 2010 raptor surveys (Table 4-6). Among these species, three are state-listed as species of special concern: black-and-white warbler (*Mniotitla varia*), chestnut-sided warbler (*Dendroica pensylvanica*) , and white-throated sparrow (*Zonotrichia albicollis*) .

Table 4-6. Non-raptor avian species observed incidentally during raptor surveys from Johnson and Kingsbury Ridges, Bingham Wind Project, Spring 2010

Common name	Scientific name	Status
American crow	*Corvus brachyrhynchos*	
American goldfinch	*Carduelis tristis*	
American robin	*Turdus migratorius*	
barred owl	*Strix varia*	
black-and-white warbler	*Mniotilta varia*	special concern
black-capped chickadee	*Poecile atricapilla*	
belted kingfisher	*Megaceryle alcyon*	
brown-headed cowbird	*Molothrus ater*	
blue jay	*Cyanocitta cristata*	
brown creeper	*Certhia americana*	
black-throated green warbler	*Dendroica virens*	
chipping sparrow	*Spizella passerina*	
common raven	*Corvus corax*	
common yellowthroat	*Geothlypis trichas*	
chestnut-sided warbler	*Dendroica pensylvanica*	special concern
double-crested cormorant	*Phalacrocorax auritus)*	
dark-eyed junco	*Junco hyemalis*	
golden-crowned kinglet	*Regulus satrapa*	
hairy woodpecker	*Picoides villosus*	
hermit thrush	*Catharus guttatus*	
house wren	*Troglodytes aedon*	
magnolia warbler	*Dendroica magnolia*	
mourning dove	*Zenaida macroura*	
Nashville warbler	*Vermivora ruficapilla*	
northern flicker	*Colaptes auratus*	
northern mockingbird	*Mimus polyglottos*	
ovenbird	*Seiurus aurocapillus*	
pileated woodpecker	*Dryocopus pileatus*	
purple finch	*Carpodacus purpureus*	
ruby-crowned kinglet	*Regulus calendula*	
ruffed grouse	*Bonasa umbellus*	
song sparrow	*Melospiza melodia*	
Swainson's thrush	*Catharus ustulatus*	
winter wren	*Troglodytes troglodytes*	
white-throated sparrow	*Zonotrichia albicollis*	special concern
white-winged crossbill	*Loxia leucoptera*	
yellow-bellied sapsucker	*Empidonax flaviventris*	
yellow-rumped warbler	*Dendroica coronata*	

4.4 DISCUSSION

Of the 56 raptor observations made in the study area (from both observation locations combined) during the spring 2010 surveys, 61 percent of observations occurred within the Project area. It should be noted that the locations where raptors were observed in the study area are subject to observer bias. Birds in closer proximity to the observation locations would be more likely to be seen than birds occurring at greater distances from the observer. Also birds that traveled outside of the observer's view shed would have gone undetected.

The survey effort and results of regional spring 2010 HMANA raptor surveys are available in Appendix C Table 5. The passage rates at Johnson and Kingsbury Ridges are comparable to the rates reported at regional HMANA locations in Maine, New Hampshire, and Massachusetts; however, when comparing the Bingham results to HMANA survey results, it should be considered that HMANA surveys typically do not count birds that are not actively migrating. The overall passage rate for migrants at the Project was 0.09 raptors/hr; this passage rate is much lower than the results at the other HMANA survey locations.

The flight paths of raptors observed at the Project varied between survey dates and were influenced by varying wind direction and weather. The two survey days which experienced the highest raptor counts (May 13 and May 5) were characterized by moderate north winds; however, low pressure systems had recently passed or settled into the region on those dates. Seasonal timing and weather both likely influenced the daily activity rates. During raptor migration, flight pathways and flight heights along ridges, side slopes, and across valleys may vary seasonally, daily, or hourly. Raptors may shift and use different ridgelines and cross different valleys from year to year or season to season. Weather and wind are major factors that influence migration paths as well as flight heights. Wind strongly affects the propensity of raptors to congregate along 'leading lines' or topographic features (Richardson 1998). Wind, air temperature, and cloud cover influence the development of updrafts and thermals used by raptors while making long-distance flights.

The behaviors and flight heights of raptors observed in the different topographical positions of the study area were typical of actively migrating raptors as well as non-migrant raptors traveling between locations in the general area. Raptors observed were primarily moving between resources in the area; few foraging behaviors were seen during the spring 2010 surveys.

Variations in flight heights among sites, and among survey days at a single site are due to variable weather conditions and the particular flight behaviors of different raptor species. Typically, *accipiters* and falcons use up-drafts from side slopes to gain lift and, therefore, usually fly low over ridgelines. *Buteos* tend to use lift from thermals that develop over side slopes and valleys and tend to fly high during hours of peak thermal development. Raptors (*accipiters* in particular) typically fly lower than usual during windy or inclement conditions. Local birds may fly at lower altitudes while making small scale movements between foraging locations (Barrios and Rodriguez 2004).

Although the occurrence of some raptors below maximum turbine height increases the potential for migrating raptors to come into the vicinity of the turbines, raptor mortality in the United States, outside of California, has been documented to be relatively low. For example, mortality rates found at wind developments, outside of Altamont Pass in California, have documented 0 to 0.07 fatalities/turbine/year from 2000-2004 (GAO 2005). Several recent studies, conducted in the U.S., have documented low raptor mortality with few more than 20 raptor fatalities reported at more than a dozen sites combined (Osborn *et al.* 2000, Johnson *et al.* 2002, Kerlinger 2002, Young *et al.* 2003, Erickson *et al.* 2000, Kerlinger 2006, Erickson *et al.* 2002, Johnson *et al.* 2003, Kerns and Kerlinger 2004, Arnett 2005, Koford *et al.* 2005, Fiedler *et al.* 2007, Jain *et al.* 2007, Jain *et al.* 2008, Stantec 2008, Stantec 2009a and b, Stantec 2010a and b).

Of the nine species of raptor observed during the spring 2010 surveys, one state-listed species of special concern, bald eagle, was observed. The species composition and flight behaviors documented during the spring 2010 raptor surveys at the Project are typical among the results of regional raptor migration studies, while the overall passage rates at the two observation locations were comparatively low.

Pre-construction raptor studies can provide baseline data regarding the species of raptor that occur in the area and the general flight behaviors of birds traveling through the area. However, currently there is no clear relationship between pre-construction and post-construction data for the prediction of raptor collision risk at wind sites. That is, at existing wind farms, the passage rates and percentages of birds below turbine height determined during pre-construction surveys have not been directly correlated to the actual number of raptors fatalities that have been documented during post-construction mortality studies.

Studies have documented high raptor collision avoidance behaviors at modern wind facilities (Whitfield and Madders 2006, Chamberlain *et al.* 2006). As most raptors are diurnal, raptors may be able to visually, as well as acoustically detect turbines during periods of fair weather. Foraging raptors that may become distracted by prey, or migrant raptors flying during periods of reduced visibility, may be at increased risk of collision with wind turbines.

5.0 Breeding Bird Survey

5.1 INTRODUCTION

Stantec conducted a breeding bird survey at the Project during the spring and summer of 2010. The goals of the surveys were to determine the species composition, abundance, diversity, and distribution of breeding birds in the Project area. The surveys focused effort on documenting the occurrence of endangered, threatened, or species of special concern; however, the surveys documented of all species detected either acoustically or visually during the surveys. Survey methods were modeled after the United States Geological Survey (USGS) Breeding Bird Survey methodology (Sauer *et al.* 2003).

The breeding bird survey methods were designed to be repeatable in order to compare data to other sites, as well as to compare to future data collected on-site if necessary. The 2010 survey provides baseline data of the species present in the Project area, their abundance, as well as the community structures among the different habitats present on-site.

5.2 METHODS

5.2.1 Breeding Bird Survey Point Counts

Stantec biologists conducted breeding bird point-count surveys during three separate visits to the Project area. The first visit was completed during late May, the second visit in early June, and third visit in late June 2010.

Twenty-five point-count locations were established within the proposed Project area using Global Positioning System (GPS) equipment (Figure 5-1). These locations were positioned to sample representative habitats that occur in the Project area and in proximity to the proposed turbine locations. Surveys were timed to begin approximately 15 minutes before sunrise and end six (+/-) hours after sunrise on days with suitably clear weather, mild temperatures, and when rain or wind would not inhibit the detection of birds. GPS location, time, weather, habitat, species, number of individuals, and other behavioral notes were recorded during each survey point.

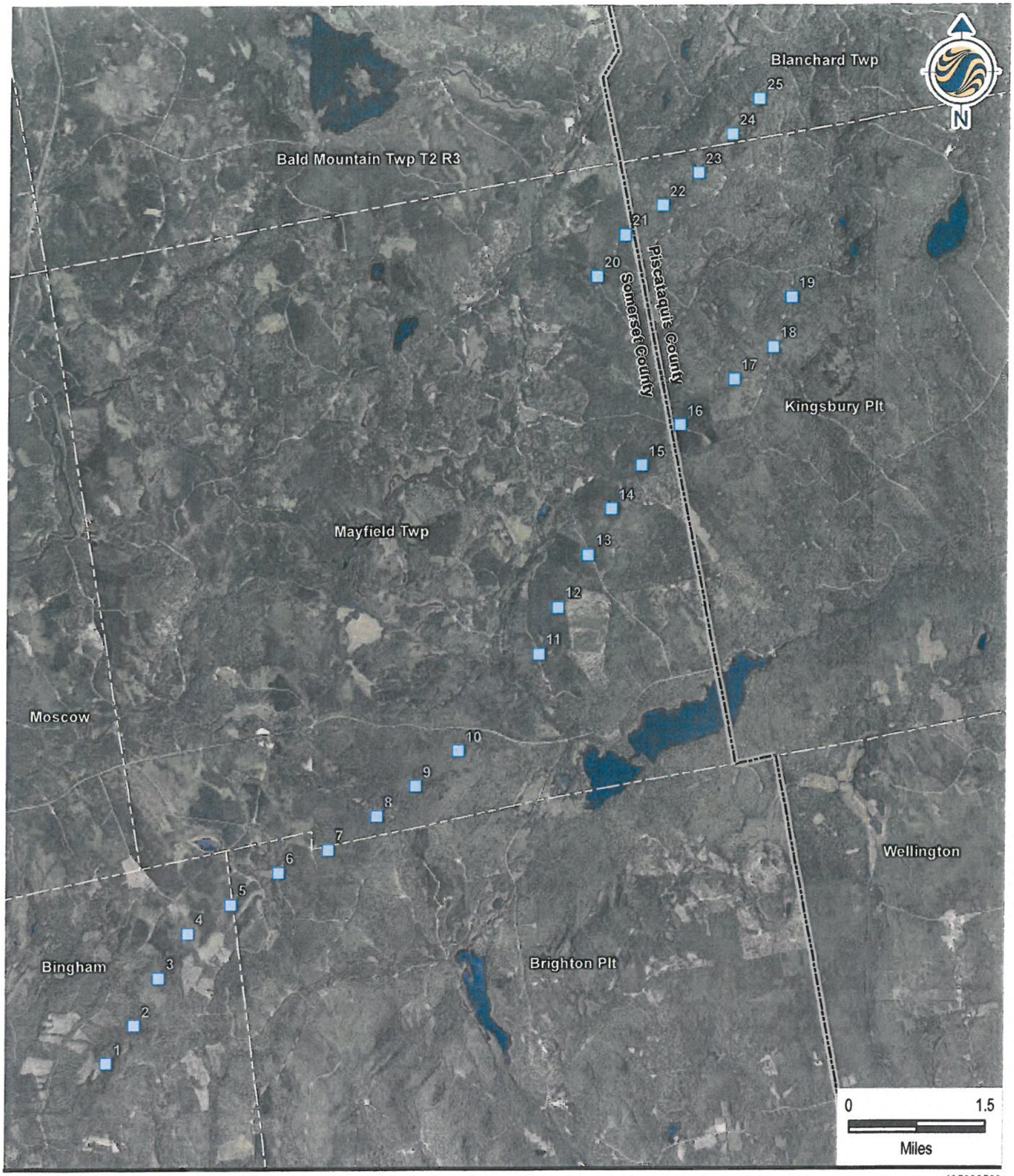
During surveys, observers orientated themselves to the north and recorded the general locations of birds within the directional quadrants of a count circle. Point-count sample periods were broken into three periods: the first three minutes, the following two minutes, and the final five minutes. For the duration of the 10 minute count surveys, the number of individuals by species was recorded on data sheets as occurring at distances of 0-50 m, 50-100 m, or greater than 100 m from the observer, or flying overhead depending upon when the bird was first seen or heard. During each consecutive time period, observers determined the location of previously recorded birds and tracked any movements within the count circle in order to avoid recounting birds. Other notes related to breeding behavior, weather conditions, and habitat descriptions were recorded. When possible, observers made digital recordings of rare or unusual birds. Only adult birds were counted when juveniles were present. Observations of birds made before and after the point-count timeframes were recorded separately as incidental observations.

5.2.2 Data Summary and Analysis

The habitats within the Project area were separated into five general community types based on the dominant vegetation cover present at each survey point: coniferous forest, deciduous forest, mixed coniferous and deciduous forest, coniferous-dominated mixed forest, and deciduous-dominated mixed forest. Habitats with similar characteristics were grouped wherever possible for simplicity of statistical analysis; however, habitat types varied to a small degree within these classifications. For example, some of the hardwood stands, although predominately hardwoods, included conifer species such as red spruce, eastern hemlock (*Tsuga canadensis*) and eastern white pine (*Pinus strobus*), and/or openings with boulder outcrops. Additionally, due to recent and past timber harvesting activities much of the forest communities are in various stages of regeneration.

Quantitative data collected during point counts were used to calculate the species richness, relative abundance, community diversity, and frequency of breeding birds within the available habitats of the Project area.

- Species richness (SR) is the total number of species that are detected at a specific point, within a habitat classification, or across the Project area.
- Relative abundance (RA) measures the number of individuals of a species within a habitat classification or across the Project area, and takes into account the number of times each point is surveyed and the number of points per habitat, or per Project area.
- Frequency (Fr) of occurrence, expressed as a percentage, measures the number of points within a habitat type, or across the Project area, where a particular species is detected.
- The Shannon Diversity Index (SDI) is a measure of species diversity in a community or habitat. SDI can provide more information about community composition than species richness alone because it takes into account relative abundance and evenness of species. It indicates not only the number of species, but also how abundance is distributed among all the species in the community or habitat.



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Stantec Consulting Services Inc.
30 Park Drive
Topsham, ME USA
04086
Phone (207) 729-1199
Fax: (207) 729-2715
www.stantec.com

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Legend

- Breeding Bird Survey Location
- County Boundary
- Town Boundary

Client/Project
Bingham Wind Project
Bingham, Maine

Figure No.
5-1

Title
Breeding Bird Survey Location Map

August 20, 2010

Species recorded as beyond 100 m from the observer, as flyovers, or birds detected incidentally were not included in the statistical analysis for relative abundance, species frequency, or community diversity because of the low probability that they were breeding in the vicinity of the point-count location. These data were used to determine overall species richness and the total number of birds observed.

5.3 RESULTS

The first of breeding bird surveys was conducted in late May (May 25, 26, and 27), the second in early June (June 9 and 10), and the final round was conducted in late June (June 22 and 25). Surveys were conducted when wind or rain conditions did not adversely affect bird detection. Wind conditions generally ranged from <1 mph to approximately 7 mph (2 to 12 kph). Weather conditions ranged from clear to overcast skies with periods of light drizzle on one day (June 10). Temperatures during the surveys ranged from 0° to 29° C (32° to 85° F).

5.3.1 Breeding Bird Survey Point Counts

Each of the 25 point count locations was surveyed during the three separate site visits. The majority of individuals were observed were within 50 m of the observer (n=312, 40%) and between 50 and 100 m of the observer (n=361, 46%). Thirteen percent (n=99) of individuals were detected at more than 100 m from the observer and 2 percent (n=15) were recorded as flyovers (Appendix D Table 1).

Including birds observed beyond 100 m from the observer and birds observed as flyovers, a total of 49 species (and one unidentified warbler) were observed within the Project area during point-count surveys (Appendix D Table 1). One additional species, veery (*Catharus fuscensces*), was observed incidentally between survey points, for a total of 50 species (Appendix D Table 2).

Including birds observed beyond 100 m from the observer and birds observed as flyovers, a total of 787 individuals were documented. The species with the greatest numbers of individuals detected were white-throated sparrow (n=89), ovenbird (*Seiurus aurocapillus*; n=62), chestnut-sided warbler (n=53), and Nashville warbler (*Vermivora ruficapilla*; n=52) (Appendix D Table 1). There were no endangered or threatened species observed; however, there were nine state-listed species of special concern documented either during surveys or incidentally: least flycatcher (*Empidonax minimus*), eastern wood-pewee (*Contopus virens*), veery, American redstart (*Setophaga ruticilla*), black-and-white warbler, Canada warbler (*Wilsonia canadensis*), chestnut-sided warbler, yellow-warbler (*Dendroica petechia*), and white-throated sparrow.

There were a total of 673 individuals observed within 100 m of the observer, excluding birds seen as flyovers (Appendix D Table 1). For birds within 100 m of the observer, excluding flyovers, point-count data were analyzed to determine SR, RA, and community diversity for all survey points combined and for each habitat type present within the Project area (Table 5-1).

For all survey points and for birds within 100 m and non-flyovers, the RA was 8.97, the SR was 44, and the SDI was 3.19 (Table 5-1).

Table 5-1. Summary of Project area breeding bird point-count results by habitat type, excluding observations of birds >100 m from the observer and flyovers

Habitat Type	# BBS Points	Total Birds Observed	Relative Abundance	Species Richness	Shannon Diversity Index
coniferous forest	3	70	7.78	20	2.72
hardwood forest	6	158	8.78	27	2.92
mixed coniferous-hardwood forest	6	168	9.33	29	3.01
coniferous-dominated mixed forest	3	98	10.89	25	2.84
hardwood-dominated mixed forest	7	179	8.52	32	3.04
All points	**25**	**673**	**8.97**	**44**	**3.19**

Hardwood-dominated mixed forest habitat had the greatest number of total birds observed (n=179), the highest SR (32), as well as the highest SDI (3.04). Coniferous-dominated mixed forest had the highest RA (10.89).

5.3.2 Species relative abundances and frequencies among habitats

The following are the values of relative abundances and frequencies for the most relatively abundant species in the five habitat types surveyed within the Project area (reference Appendix D Tables 2, 3, and 4).

5.3.2.1 Coniferous Forest

The species with the greatest RA within coniferous forest habitats were dark-eyed junco (*Junco hyemalis*; RA=1.22, Fr=100%) and yellow-rumped warbler (*Dendroica coronata*; RA=0.89, Fr=100%).

5.3.2.2 Hardwood Forest

The species with the greatest RA within hardwood forest habitats were black-throated blue warbler (RA=1.06, Fr=83%) and chestnut-sided warbler (RA=1.17, Fr=100%).

5.3.2.3 Coniferous-dominated Mixed Forest

The species with the greatest RA within coniferous-dominated mixed forest habitats were white-throated sparrow (RA=1.78, Fr=100%), Nashville warbler (RA=1.33, Fr=100%), and dark-eyed junco (RA=0.89, Fr=100%).

5.3.2.4 Hardwood-dominated Mixed Forest

The species with the greatest RA within hardwood-dominated mixed forest habitats were ovenbird (RA=0.90, Fr=100%), black-throated blue warbler (RA=0.86, Fr=86%), and chestnut-sided warbler (RA=0.76, Fr=100%).

5.3.2.5 Mixed Coniferous-hardwood Forest

The species with the greatest RA within mixed forest habitats were white-throated sparrow (RA=1.22, Fr=100%), Nashville warbler (RA=0.89, Fr=100%), and common yellowthroat (RA=0.78, Fr=83%).

5.4 DISCUSSION

The intent of the 2010 surveys was to document the occurrence of species of conservation concern as well as to provide baseline data of all species breeding within the Project area. The surveys were conducted during the peak nesting period, and were initiated in early morning when birds are typically the most vocal. In addition, these surveys targeted optimal weather conditions that would allow for maximum detection of vocalizing birds. Certain species of bird vocalize less frequently and are, therefore, often under-represented during breeding bird surveys (Farnsworth *et al.* 2002). However, the 2010 surveys used standard methods that are comparable to other breeding bird surveys conducted in the region; therefore, the results of the surveys provide a suitable reflection of the baseline breeding bird community in the Project area.

Among the habitats sampled, hardwood dominated mixed 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. However, coniferous-dominated mixed forest had the greatest relative abundance of birds.

Of the 50 species documented on-site during the 2010 surveys, all are generally common and regionally abundant, and are representative of the habitats in which they were detected. There were no endangered or threatened species; however, there were nine special concern species observed on-site.

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Appendix A

Radar survey results

Appendix A Table 1. Survey dates, results, level of effort, and weather - Bingham Wind Project, Spring 2010									
Date	Sunset	Sunrise	Passage Rate	Flight Direction	Flight Height (m)	% Below 152 m	Temperature (C)	Wind Speed (m/s)	Wind Direction (degrees)
4/19	19:29	5:46	85	117	238	30%	5	8	332
4/20	19:30	5:45	556	72	229	39%	7	6	320
4/21	19:31	5:43	642	350	497	12%	7	4	144
4/29	19:41	5:30	51	88	214	49%	6	12	312
5/1	19:44	5:27	1231	35	381	16%	15	6	236
5/4	19:47	5:23	353	107	289	24%	10	8	319
5/5	19:49	5:22	594	23	475	7%	13	8	212
5/6	19:50	5:20	124	84	231	40%	7	13	304
5/13	19:58	5:11	699	56	201	52%	9	5	311
5/14	19:59	5:10	659	42	236	40%	10	6	271
5/15	20:01	5:09	540	54	156	65%	7	7	310
5/16	20:02	5:08	600	70	167	57%	10	9	340
5/17	20:03	5:07	1103	31	371	19%	12	3	106
5/18	20:04	5:06	524	39	306	19%	9	6	184
5/20	20:06	5:04	582	72	197	51%	11	7	258
5/21	20:07	5:03	797	21	327	13%	11	8	197
5/22	20:08	5:02	540	33	424	11%	13	7	215
5/23	20:10	5:01	497	46	321	20%	15	7	258
5/25	20:12	5:00	275	75	280	29%	13	4	173
5/26	20:13	4:59	563	22	334	12%	10	6	214
Entire Season			**543**	**43**	**355**	**21%**	**10**	**7**	**251**

Appendix A Table 2. Summary of passage rates by hour, night, and for entire season - Bingham Wind Project, Spring 2010

Night of	Passage Rate (targets/km/hr) by hour after sunset										Entire Night			
	1	2	3	4	5	6	7	8	9	10	Mean	Median	Stdev	SE
4/19	64	57	82	75	96	96	93	79	68	143	85	80	24	8
4/20	364	646	796	718	686	750	525	593	325	161	556	620	210	66
4/21	539	571	864	836	536	796	704	896	464	211	642	638	217	69
4/29	21	89	71	57	64	43	54	50	32	25	51	52	21	7
5/1	1032	561	889	Rain	1082	1675	2193	1529	1779	343	1231	1082	605	202
5/4	375	721	625	839	136	164	321	204	132	11	353	263	283	89
5/5	523	1014	1068	489	414	479	496	625	707	129	594	510	279	88
5/6	21	418	261	207	179	64	39	17	32	0	124	52	138	44
5/13	461	1093	1286	843	743	707	564	375	221	N/A	699	707	341	114
5/14	229	718	839	811	861	611	489	718	657	N/A	659	718	200	67
5/15	43	971	1079	921	564	525	421	232	104	N/A	540	525	382	127
5/16	282	757	743	661	807	764	596	571	218	N/A	600	661	214	71
5/17	443	829	1286	1661	1454	1636	1207	1039	371	N/A	1103	1207	476	159
5/18	379	736	789	614	539	568	564	329	200	N/A	524	564	191	64
5/20	346	764	811	839	725	579	386	204	N/A	N/A	582	652	242	86
5/21	411	736	804	979	843	1007	843	757	N/A	N/A	797	823	184	65
5/22	325	621	668	711	704	671	611	532	21	N/A	540	621	228	76
5/23	350	686	779	586	618	557	379	432	86	N/A	497	557	209	70
5/25	21	264	268	375	236	368	Rain	596	68	N/A	275	266	182	64
5/26	257	1200	1560	975	511	296	139	104	21	N/A	563	296	550	183
Entire Season	**324**	**673**	**778**	**695**	**590**	**618**	**559**	**494**	**306**	**128**	**543**	**538**	**403**	**30**

0 indicates no targets counted for that hour; N/A indicates no data for that hour

Appendix A Table 3. Mean Nightly Flight Direction- Bingham Wind Project, Spring 2010		
Night of	**Mean Flight Direction**	**Circular Stdev**
4/19	117	62
4/20	72	47
4/21	350	62
4/29	88	52
5/1	35	45
5/4	107	64
5/5	23	38
5/6	84	38
5/13	56	33
5/14	42	33
5/15	54	39
5/16	70	39
5/17	31	53
5/18	39	40
5/20	72	44
5/21	21	30
5/22	33	45
5/23	46	42
5/25	75	37
5/26	22	54
Entire Season	**43**	**51**

Appendix A Table 4. Summary of mean flight heights by hour, night, and for entire season - Bingham Wind Project, Spring 2010

Night of	Mean Flight Height (m) by hour after sunset										Entire Night				# of targets below 152 meters	% of targets below 152 meters
	1	2	3	4	5	6	7	8	9	10	Mean	Median	STDV	SE		
4/19	117	231	226	252	238	272	241	200	228	260	238	219	147	46	66	30%
4/20	229	246	235	233	223	211	247	228	202	222	229	195	155	49	551	39%
4/21	309	431	495	538	564	500	468	426	511	639	497	442	303	96	534	12%
4/29	136	287	167	148	237	177	303	189	123	287	214	161	145	46	44	49%
5/1	181	279	Rain	Rain	468	388	396	334	377	367	381	323	242	85	1040	16%
5/4	257	275	304	343	223	284	248	234	260	68	289	245	202	64	201	24%
5/5	356	427	450	507	508	517	503	449	439	505	475	415	270	85	240	7%
5/6	280	270	180	180	221	288	390	43	217	N/A	231	184	151	50	69	40%
5/13	198	187	181	170	133	232	245	263	289	N/A	201	146	180	60	600	52%
5/14	218	245	328	245	210	179	252	200	171	N/A	236	181	187	62	726	40%
5/15	223	166	156	140	170	117	137	149	172	N/A	156	102	147	49	609	65%
5/16	163	184	166	137	170	170	199	148	112	N/A	167	116	149	50	525	57%
5/17	320	551	502	358	267	288	304	295	324	N/A	371	298	259	86	717	19%
5/18	269	345	326	308	261	282	272	265	317	N/A	306	266	173	58	466	19%
5/20	202	259	147	155	137	184	379	315	N/A	N/A	197	142	196	69	323	51%
5/21	298	389	297	304	282	315	358	361	N/A	N/A	327	295	182	64	676	13%
5/22	281	492	499	442	400	369	334	392	356	N/A	424	355	260	87	370	11%
5/23	321	415	327	305	260	261	244	297	416	N/A	321	280	194	65	185	20%
5/25	283	285	273	275	335	298	Rain	238	230	N/A	280	259	173	61	138	29%
5/26	415	347	316	328	351	298	264	349	820	N/A	334	302	174	58	132	12%
Entire Season	**253**	**316**	**293**	**283**	**283**	**281**	**304**	**269**	**309**	**335**	**355**	**291**	**247**	**1**	**8212**	**21%**

– indicates no targets counted for that hour   N/A indicates no data for that hour

Appendix A Table 5. 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									
Ellenberg, Clinton Cty, NY	40	n/a	Great Lakes plain/ADK foothills	110	n/a	30	338	(125 m) 20%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
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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

Note:
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.

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Vermont Community Wind Farm, Orleans Cty, VT	15	90	Forested ridge	435	49-771	48	320	(130m) 22%	Stantec Consulting Services Inc. 2009. Spring and Summer 2009 Bird and Bat Survey Report. Prepared for Vermont Community Wind Farm, LLC.
Moresville, Delaware Cty, NY	30	275	Forested ridge	230	30-575	53	314	(125m)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

Note:

[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.

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Appendix B

Bat survey results

Appendix B Table 1. Summary of acoustic bat data and weather during each survey night at the Bessey Met High detector – Spring 2010

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (celsius)
04/13/09	1												0		
04/14/09	1												0		
04/15/09	1												0	5.9	3.3
04/16/09	1												0	5.0	2.6
04/17/09	1												0		-0.6
04/18/09	1												0	4.4	0.9
04/19/09	1												0	8.4	6.2
04/20/09	1												0	6.5	10.6
04/21/09	1												0	6.7	9.3
04/22/09	1												0	2.2	9.9
04/23/09	1												0	9.2	5.4
04/24/09	1												0	4.1	11.0
04/25/09	1												0	2.4	9.3
04/26/09	1												0	4.9	12.1
04/27/09	1												0	5.8	3.4
04/28/09	1												0	8.5	2.8
04/29/09	1					1							1	10.4	5.2
04/30/09	1					1							1	6.4	12.2
05/01/09	1												0	2.1	18.6
05/02/09	1												0	7.4	21.7
05/03/09	1												0	9.2	16.7
05/04/09	1												0	8.0	13.1
05/05/09	1												0	4.1	13.8
05/06/09	1												0	10.0	8.8
05/07/09	1												0	8.5	7.0
05/08/09	1												0	3.6	4.6
05/09/09	1												0	11.7	2.3
05/10/09	1												0	9.0	-0.3
05/11/09	1												0	4.8	8.6
05/12/09	1												0	7.1	7.5
05/13/09	1												0	6.4	11.2
05/14/09	1												0	4.5	12.6
05/15/09	1												0	6.6	9.8
05/16/09	1					1							1	8.6	13.2
05/17/09	1					1							1	4.6	16.6
05/18/09	1												0	7.2	13.6
05/19/09	1												0	7.2	9.1
05/20/09	1	1											1	6.8	18.4
05/21/09	1												0	4.4	13.9
05/22/09	1												0	5.6	15.1
05/23/09	1												0	7.7	17.2
05/24/09	1												0	6.2	23.6
05/25/09	1												0	6.2	26.1
05/26/09	1												0	7.1	19.7
05/27/09	1					1							1	7.9	14.7
05/28/09	1												0	5.8	15.6
05/29/09	1												0	6.5	16.0
05/30/09	1	1											1	9.9	14.2
05/31/09	1												0	7.3	16.3
06/01/09	1										1		1	6.1	14.5
06/02/09	1												0		
06/03/09	1												0		
06/04/09	1	1		1									2		
06/05/09	1												0		
06/06/09	1												0		
06/07/09	1												0		
06/08/09	1												0		
By Species		3	0	1	0	5	0	0	0	0	1	0	10		
By Guild		4			0	5	0			1					
		BBSH			HB	MYSP	RBTB			UNKN			Total		

Appendix B Table 2. Summary of acoustic bat data and weather during each survey night at the Bessey Met Low detector – Spring 2010

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (celsius)
04/13/09	1												0		
04/14/09	1												0		
04/15/09	1												0	6	3
04/16/09	1												0	5	3
04/17/09	1												0		-1
04/18/09	1												0	4	1
04/19/09	1												0	8	6
04/20/09	1												0	6	11
04/21/09	1												0	7	9
04/22/09	1												0	2	10
04/23/09	1												0	9	5
04/24/09	1					1							1	4	11
04/25/09	1												0	2	9
04/26/09	1												0	5	12
04/27/09	1												0	6	3
04/28/09	1												0	9	3
04/29/09	1									1			1	10	5
04/30/09	1												0	6	12
05/01/09	1												0	2	19
05/02/09	1												0	7	22
05/03/09	1												0	9	17
05/04/09	1												0	8	13
05/05/09	1	1											1	4	14
05/06/09	1									1			1	10	9
05/07/09	1												0	9	7
05/08/09	1												0	4	5
05/09/09	1												0	12	2
05/10/09	1												0	9	0
05/11/09	1									1			1	5	9
05/12/09	1												0	7	8
05/13/09	1												0	6	11
05/14/09	1												0	5	13
05/15/09	1												0	7	10
05/16/09	1									1			1	9	13
05/17/09	1												0	5	17
05/18/09	1												0	7	14
05/19/09	1												0	7	9
05/20/09	1												0	7	18
05/21/09	1												0	4	14
05/22/09	1												0	6	15
05/23/09	1	1			1								2	8	17
05/24/09	1									4			4	6	24
05/25/09	1									1			1	6	26
05/26/09	1												0	7	20
05/27/09	1												0	8	15
05/28/09	1												0	6	16
05/29/09	1												0	7	16
05/30/09	1												0	10	14
05/31/09	1				1								1	7	16
06/01/09	1												0	6	15
06/02/09	1												0		
06/03/09	1	1											1		
06/04/09	1										1		1		
06/05/09	1				1								1		
06/06/09	1												0		
06/07/09	1									1			1		
06/08/09	1												0		
By Species		3	0	0	3	1	0	0	0	10	1	0	18		
By Guild		3			3	1	0			11					
		BBSH			HB	MYSP	RBTB			UNKN			Total		

* 1 = Detector functioned for the entire night; 0 = Non-operational for all or part of the night

Appendix B Table 3. Summary of acoustic bat data and weather during each survey night at the Bigelow Ridge Tree detector – Spring 2010

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (celsius)
04/14/09	1												0		
04/15/09	1												0		
04/16/09	1												0	6	3
04/17/09	1												0	5	3
04/18/09	1												0		-1
04/19/09	1												0	4	1
04/20/09	1												0	8	6
04/21/09	1												0	6	11
04/22/09	1												0	7	9
04/23/09	1												0	2	10
04/24/09	1												0	9	5
04/25/09	1												0	4	11
04/26/09	1												0	2	9
04/27/09	1												0	5	12
04/28/09	1												0	6	3
04/29/09	1												0	9	3
04/30/09	1									2			2	10	5
05/01/09	1												0	6	12
05/02/09	1												0	2	19
05/03/09	1												0	7	22
05/04/09	1					1							1	9	17
05/05/09	1	2				1				2			5	8	13
05/06/09	1												0	4	14
05/07/09	1					1							1	10	9
05/08/09	1												0	9	7
05/09/09	1												0	4	5
05/10/09	1												0	12	2
05/11/09	1					1				1			2	9	0
05/12/09	1												0	5	9
05/13/09	1					3							3	7	8
05/14/09	1					1				2			3	6	11
05/15/09	1									1			1	5	13
05/16/09	1												0	7	10
05/17/09	1									3			3	9	13
05/18/09	1												0	5	17
05/19/09	1												0	7	14
05/20/09	1									5			5	7	9
05/21/09	1					2							2	7	18
05/22/09	1												0	4	14
05/23/09	1					2				1			3	6	15
05/24/09	1									1			1	8	17
05/25/09	1									1			1	6	24
05/26/09	1									7			7	6	26
05/27/09	1					10							10	7	20
05/28/09	1					9				9			18	8	15
05/29/09	1					5				3			8	6	16
05/30/09	1					1							1	7	16
05/31/09	1					1							1	10	14
06/01/09	1	1				3				7			11	7	16
06/02/09	1												0	6	15
By Species		3	0	0	0	41	0	0	0	45	0	0	89		
By Guild		3			0	41	0			45					
		BBSH			HB	MYSP	RBTB			UNKN			Total		

* 1 = Detector functioned for the entire night; 0 = Non-operational for all or part of the night

Appendix B Table 4. Summary of acoustic bat data and weather during each survey night at the Crocket Met High detector – Spring 2010

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (celsius)
04/14/09	1												0		
04/15/09	1												0		
04/16/09	1												0	6	3
04/17/09	1												0	5	3
04/18/09	1												0		-1
04/19/09	1												0	4	1
04/20/09	1												0	8	6
04/21/09	1												0	6	11
04/22/09	1												0	7	9
04/23/09	1												0	2	10
04/24/09	1												0	9	5
04/25/09	1												0	4	11
04/26/09	1												0	2	9
04/27/09	1												0	5	12
04/28/09	1												0	6	3
04/29/09	1												0	9	3
04/30/09	1												0	10	5
05/01/09	1												0	6	12
05/02/09	1												0	2	19
05/03/09	1									1			1	7	22
05/04/09	1												0	9	17
05/05/09	1		1										1	8	13
05/06/09	1												0	4	14
05/07/09	1									1			1	10	9
05/08/09	1												0	9	7
05/09/09	1												0	4	5
05/10/09	1												0	12	2
05/11/09	1												0	9	0
05/12/09	1												0	5	9
05/13/09	1									1			1	7	8
05/14/09	1												0	6	11
05/15/09	1												0	5	13
05/16/09	1												0	7	10
05/17/09	1												0	9	13
05/18/09	1												0	5	17
05/19/09	1												0	7	14
05/20/09	1												0	7	9
05/21/09	1												0	7	18
05/22/09	1												0	4	14
05/23/09	1												0	6	15
05/24/09	1										1		1	8	17
05/25/09	1												0	6	24
05/26/09	1									1			1	6	26
05/27/09	1					1				1			2	7	20
05/28/09	1												0	8	15
05/29/09	1												0	6	16
05/30/09	1												0	7	16
05/31/09	1												0	10	14
06/01/09	1												0	7	16
06/02/09	1												0	6	15
06/03/09	1												0		
06/04/09	1												0		
06/05/09	1												0		
06/06/09	1												0		
06/07/09	1												0		
06/08/09	1												0		
By Species		0	1	0	0	1	0	0	0	5	1	0	8		
By Guild		1			0	1	0			6					
		BBSH			HB	MYSP	RBTB			UNKN			Total		

* 1 = Detector functioned for the entire night; 0 = Non-operational for all or part of the night

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Appendix B Table 5. Summary of acoustic bat data and weather during each survey night at the Crocket Met Low detector – Spring 2010

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (celsius)
04/14/09	1												0		
04/15/09	1												0		
04/16/09	1												0	6	3
04/17/09	1												0	5	3
04/18/09	1												0		-1
04/19/09	1												0	4	1
04/20/09	1												0	8	6
04/21/09	1												0	6	11
04/22/09	1												0	7	9
04/23/09	1												0	2	10
04/24/09	1					1							1	9	5
04/25/09	1												0	4	11
04/26/09	1												0	2	9
04/27/09	1												0	5	12
04/28/09	1												0	6	3
04/29/09	1					1							1	9	3
04/30/09	1					1							1	10	5
05/01/09	1												0	6	12
05/02/09	1												0	2	19
05/03/09	1												0	7	22
05/04/09	1	1								1			2	9	17
05/05/09	1												0	8	13
05/06/09	1												0	4	14
05/07/09	1												0	10	9
05/08/09	1												0	9	7
05/09/09	1												0	4	5
05/10/09	1												0	12	2
05/11/09	1												0	9	0
05/12/09	1												0	5	9
05/13/09	1												0	7	8
05/14/09	1					1							1	6	11
05/15/09	1												0	5	13
05/16/09	1									1			1	7	10
05/17/09	1												0	9	13
05/18/09	1												0	5	17
05/19/09	1												0	7	14
05/20/09	1					1				1			2	7	9
05/21/09	1												0	7	18
05/22/09	1												0	4	14
05/23/09	1												0	6	15
05/24/09	1	1											1	8	17
05/25/09	1												0	6	24
05/26/09	1									1	1		2	6	26
05/27/09	1												0	7	20
05/28/09	1												0	8	15
05/29/09	1												0	6	16
05/30/09	1												0	7	16
05/31/09	1												0	10	14
06/01/09	1										1		1	7	16
06/02/09	1												0	6	15
06/03/09	1				1								1		
06/04/09	1												0		
06/05/09	1												0		
06/06/09	1												0		
06/07/09	1				1								1		
06/08/09	1												0		
By Species		2	0	0	2	5	0	0	0	4	2	0	15		
By Guild		2			2	5	0			6					
		BBSH			HB	MYSP	RBTB			UNKN			Total		

* 1 = Detector functioned for the entire night; 0 = Non-operational for all or part of the night

Appendix B Table 6. Summary of acoustic bat data and weather during each survey night at the Johnson Met Low detector – Spring 2010															
		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (celsius)
04/14/09	1												0		
04/15/09	1												0		
04/16/09	1												0	5.9	3.3
04/17/09	1												0	5.0	2.6
04/18/09	1												0		-0.6
04/19/09	1												0	4.4	0.9
04/20/09	1												0	8.4	6.2
04/21/09	1												0	6.5	10.6
04/22/09	1												0	6.7	9.3
04/23/09	1												0	2.2	9.9
04/24/09	1												0	9.2	5.4
04/25/09	1												0	4.1	11.0
04/26/09	1												0	2.4	9.3
04/27/09	1												0	4.9	12.1
04/28/09	1									1			1	5.8	3.4
04/29/09	1												0	8.5	2.8
04/30/09	1					1							1	10.4	5.2
05/01/09	1												0	6.4	12.2
05/02/09	1												0	2.1	18.6
05/03/09	1												0	7.4	21.7
05/04/09	1					1							1	9.2	16.7
05/05/09	1										1		1	8.0	13.1
05/06/09	1												0	4.1	13.8
05/07/09	1												0	10.0	8.8
05/08/09	1												0	8.5	7.0
05/09/09	1												0	3.6	4.6
05/10/09	1												0	11.7	2.3
05/11/09	1												0	9.0	-0.3
05/12/09	1												0	4.8	8.6
05/13/09	1												0	7.1	7.5
05/14/09	1												0	6.4	11.2
05/15/09	1												0	4.5	12.6
05/16/09	1												0	6.6	9.8
05/17/09	1			1									1	8.6	13.2
05/18/09	1												0	4.6	16.6
05/19/09	1												0	7.2	13.6
05/20/09	1									1			1	7.2	9.1
05/21/09	1										1		1	6.8	18.4
05/22/09	1												0	4.4	13.9
05/23/09	1												0	5.6	15.1
05/24/09	1				1	1							2	7.7	17.2
05/25/09	1												0	6.2	23.6
05/26/09	1			1									1	6.2	26.1
05/27/09	1												0	7.1	19.7
05/28/09	1			2							3		5	7.9	14.7
05/29/09	1												0	5.8	15.6
05/30/09	1				1						1		2	6.5	16.0
05/31/09	1												0	9.9	14.2
06/01/09	1												0	7.3	16.3
06/02/09	1												0	6.1	14.5
By Species		0	0	4	2	3	0	0	0	2	6	0	17		
By Guild		4			2	3	0			8					
		BBSH			HB	MYSP	RBTB			UNKN			Total		

* 1 = Detector functioned for the entire night; 0 = Non-operational for all or part of the night

Appendix B Table 7. Summary of acoustic bat data and weather during each survey night at the Johnson Met Tree detector – Spring 2010

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (celsius)
04/14/09	1												0		
04/15/09	1												0		
04/16/09	1												0	6	3
04/17/09	1												0	5	3
04/18/09	1												0		-1
04/19/09	1												0	4	1
04/20/09	1						1			1			2	8	6
04/21/09	1												0	6	11
04/22/09	1												0	7	9
04/23/09	1												0	2	10
04/24/09	1												0	9	5
04/25/09	1					1							1	4	11
04/26/09	1												0	2	9
04/27/09	1												0	5	12
04/28/09	1									1			1	6	3
04/29/09	1												0	9	3
04/30/09	1	1				3							4	10	5
05/01/09	1					1							1	6	12
05/02/09	1	1		1		1							3	2	19
05/03/09	1										1		1	7	22
05/04/09	1												0	9	17
05/05/09	1		1								2		3	8	13
05/06/09	1												0	4	14
05/07/09	1					1							1	10	9
05/08/09	1												0	9	7
05/09/09	1												0	4	5
05/10/09	1												0	12	2
05/11/09	1					1							1	9	0
05/12/09	1												0	5	9
05/13/09	1												0	7	8
05/14/09	1				1	2				1			4	6	11
05/15/09	1	1				2				1			4	5	13
05/16/09	1												0	7	10
05/17/09	1					1				1			2	9	13
05/18/09	1					1				1			2	5	17
05/19/09	1												0	7	14
05/20/09	1									2			2	7	9
05/21/09	1									2			2	7	18
05/22/09	1					1				1			2	4	14
05/23/09	1					1				1	1		3	6	15
05/24/09	1					3							3	8	17
05/25/09	1												0	6	24
05/26/09	1		1			1				1	1		4	6	26
05/27/09	1	1				1							2	7	20
05/28/09	1	3								1			4	8	15
05/29/09	1					1							1	6	16
05/30/09	1				2								2	7	16
05/31/09	1	1											1	10	14
06/01/09	1	1			1	1				1			4	7	16
06/02/09	1										1		1	6	15
By Species		9	2	1	4	23	1	0	0	15	6	0	61		
By Guild		12			4	23	1			21					
		BBSH			HB	MYSP	RBTB			UNKN			Total		

* 1 = Detector functioned for the entire night; 0 = Non-operational for all or part of the night

Appendix B Table 8. Summary of acoustic bat data and weather during each survey night at the Kingsbury Ridge Tree detector – Spring 2010

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (celsius)
04/15/09	1												0		
04/16/09	1												0		
04/17/09	1												0	6	3
04/18/09	1												0	5	3
04/19/09	1												0		-1
04/20/09	1												0	4	1
04/21/09	1					2				1			3	8	6
04/22/09	1												0	6	11
04/23/09	1												0	7	9
04/24/09	1												0	2	10
04/25/09	1					1							1	9	5
04/26/09	1												0	4	11
04/27/09	1												0	2	9
04/28/09	1												0	5	12
04/29/09	1									1			1	6	3
04/30/09	1					1				2			3	9	3
05/01/09	1												0	10	5
05/02/09	1					2							2	6	12
05/03/09	1												0	2	19
05/04/09	1												0	7	22
05/05/09	1												0	9	17
05/06/09	1												0	8	13
05/07/09	1									2			2	4	14
05/08/09	1												0	10	9
05/09/09	1												0	9	7
05/10/09	1												0	4	5
05/11/09	1					1				1			2	12	2
05/12/09	1									1			1	9	0
05/13/09	1					1				3			4	5	9
05/14/09	1												0	7	8
05/15/09	1												0	6	11
05/16/09	1												0	5	13
05/17/09	1					1				2			3	7	10
05/18/09	1									1			1	9	13
05/19/09	1									1			1	5	17
05/20/09	1												0	7	14
05/21/09	1												0	7	9
05/22/09	1					1							1	7	18
05/23/09	1					2				1			3	4	14
05/24/09	1												0	6	15
05/25/09	1									2			2	8	17
05/26/09	1												0	6	24
05/27/09	1					1							1	6	26
05/28/09	1												0	7	20
05/29/09	1									1			1	8	15
05/30/09	1												0	6	16
05/31/09	1												0	7	16
06/01/09	1												0	10	14
06/02/09	1												0	7	16
By Species		0	0	0	0	13	0	0	0	19	0	0	32		
By Guild		0			0	13	0			19					
		BBSH			HB	MYSP	RBTB			UNKN			Total		

* 1 = Detector functioned for the entire night; 0 = Non-operational for all or part of the night

Appendix C

Raptor survey results

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Appendix C Table 1a. Daily total observations of raptor species at Johnson Ridge, Bingham

Species	4/30/2010	5/6/2010	5/13/2010	5/18/2010	5/21/2010	Total
American kestrel					1	1
bald eagle					1	1
broad-winged hawk	1				1	2
Cooper's hawk			2			2
merlin			1			1
osprey						0
red-tailed hawk			3			3
sharp-shinned hawk	1					1
turkey vulture		8	7	7	3	25
unidentified raptor			1			1
Total	**2**	**8**	**14**	**7**	**6**	**37**

Appendix C Table 1b. Daily total observations of raptor species at Kingsbury Ridge, Bingham Wind Project, Spring 2010

Species	3/19/2010	3/25/2010	4/2/2010	4/15/2010	4/20/2010	4/30/2010	5/5/2010	5/13/2010	5/18/2010	5/21/2010	Total
American kestrel											0
bald eagle		4					1				5
broad-winged hawk							1				1
Cooper's hawk											0
merlin											0
osprey			1							1	2
red-tailed hawk			2				1	1			4
sharp-shinned hawk			1						1		2
turkey vulture							1		2	2	5
unidentified raptor											0
Total	**0**	**4**	**4**	**0**	**0**	**0**	**4**	**1**	**3**	**3**	**19**

Appendix C Table 2a. Hourly summary of raptor observations at Johnson Ridge, Bingham Wind Project, Spring 2010

Species	8:00-9:00	9:00-10:00	10:00-11:00	11:00-12:00	12:00-1:00	1:00-2:00	2:00-3:00	3:00-4:00	Total
American kestrel				1					1
bald eagle			1						1
broad-winged hawk	1					1			2
Cooper's hawk			1		1				2
merlin					1				1
osprey									
red-tailed hawk					2		1		3
sharp-shinned hawk	1								1
turkey vulture			9	6	6	1	3		25
unidentified raptor				1					1
Total	**2**	**0**	**11**	**8**	**10**	**2**	**4**	**0**	**37**

Appendix C Table 2b. Hourly summary of raptor observations at Kingsbury Ridge, Bingham Wind Project, Spring 2010

Species	8:00-9:00	9:00-10:00	10:00-11:00	11:00-12:00	12:00-1:00	1:00-2:00	2:00-3:00	3:00-4:00	Total
American kestrel									
bald eagle			2				2	1	5
broad-winged hawk							1		1
Cooper's hawk									
merlin									
osprey				1				1	2
red-tailed hawk			3					1	4
sharp-shinned hawk				1			1		2
turkey vulture			3				2		5
unidentified raptor									
Total	**0**	**0**	**8**	**2**	**0**	**0**	**6**	**3**	**19**

Appendix C Table 3. Total observations of raptor species at locations in the study area, Bingham Wind Project, Spring 2010

Species	Foss Mountain	Hills outside of Project	Johnson Ridge	Kingsbury Ridge	Valleys	Total
American kestrel					1	1
bald eagle		1	1	3	1	6
broad-winged hawk		1		1	1	3
Cooper's hawk		1			1	2
merlin		1				1
osprey			1	1		2
red-tailed hawk	1	3	1	2		7
sharp-shinned hawk		1		2		3
turkey vulture		3	17	4	6	30
unidentified raptor			1			1
Total	**1**	**11**	**21**	**13**	**10**	**56**

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Appendix C Table 4a. Number of individuals of species observed within Project boundary in proposed turbine areas (flight positions A, B and C) above or below 152 m as seen from Johnson Ridge, Bingham Wind Project, Spring 2010

Species	152 m or above	below 152 m	Total
bald eagle	1		1
broad-winged hawk			0
osprey			0
red-tailed hawk		1	1
sharp-shinned hawk			0
turkey vulture		18	18
unidentified raptor		1	1
Total	**1**	**20**	**21**

Appendix C Table 4b. Number of individuals of species observed within Project boundary in proposed turbine areas (flight positions A, B and C) above or below 152 m as seen from Kingsbury Ridge, Bingham Wind Project, Spring 2010

Species	152 m or above	below 152 m	Total
bald eagle	1	2	3
broad-winged hawk		1	1
osprey		2	2
red-tailed hawk	2		2
sharp-shinned hawk		2	2
turkey vulture		3	3
unidentified raptor			0
Total	**3**	**10**	**13**

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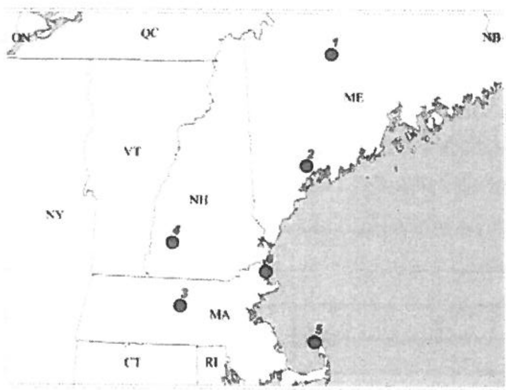
Appendix C Table 5. Summary of Regional Spring 2010 Migration Surveys*

Site Number**	Location	Observation Hours	BV	TV	OS	BE	NH	SS	CH	NG	RS	BW	RT	RL	GE	AK	ML	PG	UA	UB	UF	UE	UR	MK	TOTAL	BIRDS/ HOUR
1a	Johnson Ridge, Bingham Wind Project; ME	35	0	25	0	0	0	1	2	0	0	2	3	1	0	1	1	0	0	0	0	0	1	0	**37**	1.06
1b	Kingsbury Ridge, Bingham Wind Project; ME	70	0	5	2	5	0	2	0	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0	**19**	0.27
2	Bradbury Mountain; Pownal, ME	432.75	1	354	500	52	106	724	97	7	67	1746	292	0	0	450	44	3	10	5	3	0	13	0	**4474**	10.34
3	Barre Falls, Barre, MA	150.50	0	104	80	18	10	118	20	0	11	1101	66	0	0	31	1	0	0	0	0	0	13	0	**1573**	10.45
4	Pitcher Mountain; Stoddard, NH	23.25	0	28	3	1	2	5	1	2	2	50	8	0	2	4	0	0	0	1	0	0	8	0	**117**	5.03
5	Pilgrim Heights; North Truro, MA	280.00	10	794	174	19	13	527	39	2	15	331	155	0	0	119	72	26	1	3	3	0	2	7	**2312**	8.26
6	Plum Island; Newburyport, MA	121.33	0	18	27	0	39	133	9	0	0	0	0	0	0	305	88	5	5	1	6	0	4	0	**640**	5.27

* Data obtained from HMANA 2010.
** See map to right for site location.



Abbreviation Key:

BV - Black Vulture
TV - Turkey Vulture
OS - Osprey
BE - Bald Eagle
NH - Northern Harrier
SS - Sharp-shinned Hawk
CH - Cooper's Hawk
NG - Northern Goshawk
RS - Red-shouldered Hawk
BW - Broad-winged Hawk
RT - Red-tailed Hawk
RL - Rough-legged Hawk
GE - Golden Eagle
AK - American Kestrel
ML - Merlin
PG - Peregrine Falcon
SW - Swainson's Hawk
UR - unidentified Raptor
UB - unidentified Buteo
UA - unidentified Accipiter
UF - unidentified Falcon
UE - unidentified Eagle

Excerpt

Exhibit 7D-2: Fall 2010 Pre-Construction Avian and Bat Survey Report

Fall 2010
Avian and Bat Survey Report
for the Bingham Wind Project
In Bingham, Kingsbury, and Mayfield, Maine

Prepared for

Blue Sky West Wind, LLC
129 Middle Street,
3rd Floor
Portland, ME 04101

Prepared by

Stantec Consulting Services Inc.
30 Park Drive
Topsham, ME 04086

Stantec

Rev February 2012

Executive Summary

In advance of permitting activities for the proposed Bingham Wind Project (Project) in Somerset and Piscataquis Counties, Maine, Blue Sky West, LLC (Blue Sky) contracted Stantec Consulting Services Inc. (Stantec) to perform bird and bat surveys in the spring, summer and fall of 2010. The purpose of the field surveys was to evaluate bird and bat species presence and use of the Project area. Survey methods and work plans were developed based on past experience at other wind energy projects in Maine. The specific work described in this report was developed and discussed with the Maine Department of Inland Fisheries and Wildlife (MDIFW) and United States Fish and Wildlife (USFWS) staff at a meeting in Augusta, ME on March 5, 2010. Subsequently, a work plan was developed based on the discussions at the meeting and submitted to the agencies for review. The wildlife field surveys for the Project in 2010 included spring breeding bird surveys, spring aerial eagle nest surveys, spring and fall nocturnal radar surveys, spring, summer and fall 2010 bat acoustic surveys, and spring and fall raptor migration surveys. This report describes the methods and results for the fall 2010 radar, summer and fall bat acoustic, and fall raptor surveys. Methods and results of the spring 2010 surveys were described in a previous Spring 2010 report, and in the case of the eagle nest surveys, in a separate memo report.

The Project is in the early stages of planning; however the conceptual design for the Project during the current biological investigations included a broad area including a series of four ridgelines extending approximately 15 miles northeast through the organized town of Bingham, and the unorganized township of Mayfield and Kingsbury Plantation. The proposed turbines have an expected maximum height of 152 meters (m; 499 feet [']).

Nocturnal Radar Survey

Nocturnal radar surveys were conducted during 20 nights in fall 2010 (between September 7 and October 13) to characterize nocturnal migration activity in the Project area. These surveys were a continuation of the spring 2010 surveys, conducted on 20 nights from April 19 to May 26. Surveys were conducted using X-band marine radar, sampling from sunset to sunrise. Each hour of sampling included the recording of radar video files during horizontal and vertical operation. The radar was located on the summit of an unnamed ridge just south of Route 16 in the Town of Mayfield, centrally located within the Project area. The radar location provided nearly unobstructed views of the surrounding airspace within the radar's range in all directions.

The overall mean passage rate for the entire fall radar survey period was 803 ± 46 targets per kilometer per hour (t/km/hr). Nightly passage rates varied from 194 ± 31 on October 7 to 2,463 ± 279 t/km/hr on September 29. Mean flight direction through the Project area for the season was 234° ± 62°. The seasonal mean flight height of targets was 378 ± 1 m (1,239') above the radar site, and nightly flight heights ranged from 227 ± 2 m (745') on September 29 to 533 ± 3 m

(1,749') on October 2. The percent of targets observed flying below 152 m (499') was 20 percent for the entire season and varied by night, from 10 to 38 percent.

Bat Acoustic Survey

Fall 2010 bat acoustic surveys were a continuation of spring 2010 surveys. This report presents the results of the summer and fall 2010 surveys only, from June 3 through October 31. Eight acoustic detectors were deployed at five ridge top locations across the Project area. Three survey locations utilized meteorological (met) towers to elevate detectors at or above tree canopy height. Two additional locations did not have met towers and detectors were deployed at or below tree height at these sites. At the recommendation of MDIFW, the majority of detectors were deployed at or below tree canopy height. In order to document activity of long-distance migratory tree roosting species, the bats documented as most susceptible to collision with wind turbines, two detectors were deployed up high in two of the met towers to provide activity information above tree canopy height and near the height of the lower end of the proposed turbine rotor zone.

A total of 2,755 call sequences were recorded between June 3 and October 31, 2010 from all detectors combined. Activity increased with decreasing detector height. Detectors deployed above tree canopy in met towers (n=2) had a combined detection rate of .36 call files recorded per detector-night (files/detector-night); detectors deployed at tree canopy height in met towers (n=3) had a combined detection rate of .66 files/detector-night; detectors deployed at or below tree canopy height (n=3) had a combined detection rate of 5.3 files/detector-night. Activity also increased over time during the survey period. The maximum activity recorded in a single night by all detectors occurred on July 27 (188 total calls for all detectors combined).

Of those calls that could be identified to species or guild, the Myotis guild (MYSP) contained the highest number of call sequences (n = 1,494) identified to a taxonomic level. Seven of the eight detectors recorded calls from all five guilds (MYSP, Unknown, eastern red bat/tri-colored bat (RBTB), big brown bat, silver-haired bat and hoary bat). No calls from the red bat/tri-colored bat (RBTB) guild were recorded at the Bessey Met high or Met low detectors.

Diurnal Raptor Survey

Fall 2010 diurnal raptor migration surveys were conducted on 12 days from September 2 (Sept 2) through October 13. These surveys were a continuation of similar surveys conducted over 10 days between March 19 and May 21 in the spring of 2010. Five of those survey days were conducted at the two observation locations simultaneously, for a total of 17 observation days (5 days at Johnson Ridge and 12 days at Kingsbury Ridge). A total of 119 hours were surveyed (84 hours at Kingsbury Ridge and 35 hours at Johnson Ridge).

Over the course of the survey period, 57 observations of raptors were made from Kingsbury Ridge and 61 observations from Johnson Ridge. None of these observations were thought to be simultaneous observations between the observers at Kingsbury and Johnson Ridges. The seasonal passage rate for Kingsbury Ridge was 0.68 raptor observations per hour (raptors/hr); the seasonal passage rate for Johnson Ridge was 1.74 raptors/hr. Based on flight direction and behavior, the majority of birds observed at Johnson Ridge were suspected to be seasonally local birds while the majority of birds observed at Kingsbury Ridge were believed to be migrants. Most birds observed at Johnson Ridge were turkey vultures (*Cathartes aura*) and they were suspected to be seasonally local birds.

At Johnson Ridge, 34 percent (n=12) of the total raptor observations occurred within the Project area while at Kingsbury Ridge, 23 percent (n=13) occurred within the Project area (Figures 4-6a and 4-6b, Appendix C Tables 3a and 3b). All other observations occurred over nearby topographical features such as hills, peaks, or valleys outside of the Project area.

At Johnson Ridge, 12 observations (34%) occurred within the Project area in topographical positions where the turbines are to be sited. These birds occurred at flight heights below the proposed maximum rotor height of 152 m. At Kingsbury Ridge, 13 observations (15%) occurred within the Project area in positions where the turbines are to be sited. Of these birds, 11 birds (85% of the 13 in the Project area) occurred at flight heights below the proposed maximum rotor height.

The most commonly observed species at Kingsbury Ridge was sharp-shinned hawk (*Accipiter striatus*) and turkey vulture was the most commonly observed species at Johnson Ridge. No raptor species listed by the Endangered Species Act of 1973 (7 U.S.C. § 136, 16 U.S.C. § 1531 et seq.) as Threatened or Endangered were observed during the Fall 2010 survey period. Six observations of bald eagle (*Haliaeetus leucocephalus)*, a state-listed species of special concern, were made in the Study area. Two adult bald eagle observations occurred within the Project area and were observed below 152 meters for a period of their observed flight. Additionally three Northern Harrier (*Circus cyaneus),* a state listed species of special concern, were observed outside the Project area.

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