PHASE I AVIAN RISK ASSESSMENT

Roaring Brook Wind Power Project

Lewis County, New York

Report Prepared for:

PPM Energy

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Executive Summary

PPM Energy has proposed a utility-scale wind-power project for a predominately logged but wooded site on the Tug Hill Plateau in west-central Lewis County, New York and southwest of the Maple Ridge Wind Project. Plans are to construct approximately 40 2 megawatt (MW) class wind turbines for an estimated peak production project capacity of 80 MW. The wind turbine hub height would be 100 m (328 ft) with an approximate rotor diameter of 93 m (305 feet). This equates to maximum and minimum above ground (AGL) blade tip heights of 146.5 m (~481 ft) and 53.5 m (175.5 ft), respectively. In is anticipated that a subset of the turbines would be outfitted with synchronized red nighttime (L-864) strobe lighting near hub height, with final configuration according to Federal Aviation Administration (FAA) individual wind turbine determinations.

This report details a Phase I Avian Risk Assessment conducted for the Roaring Brook Wind Power Project (hereafter referred to as the "Project"). The purpose of a Phase I Avian Risk Assessment is to determine potential collision and displacement risk to birds from project construction and operation at a proposed site. The risk-assessment process is based on: 1) a site visit, 2) a literature and database search, and 3) written consultations with wildlife agencies (New York State Department of Environmental Conservation [NYSDEC] – Natural Heritage Program; U.S. Fish and Wildlife Service [USFWS] – State Office-website) regarding special-interest species, as well as other wildlife concerns.

The Roaring Brook Project site is located in the Tug Hill region, a portion of which is an extensive, relatively unfragmented forested landscape located between Lake Ontario and the Adirondack Mountains. The region receives the heaviest snowfall in the eastern U.S. Relatively flat, the Project site itself is a heavily logged, second-growth mostly deciduous woodland with interspersed wetlands, ponds, and streams. The turbine areas would be surrounded by extensive forest/woodland. Agricultural lands that dominate the Black River valley are within 1.5 miles (2.4 km) to the east.

A response letter from the NYSDEC listed no endangered or threatened bird species were likely to be present on site, although three rare species (Bay-breasted Warbler, Three-toed Woodpecker, and Clay-colored Sparrow) were listed as being present within several miles of the Project. None are likely to be found on the Project site because habitat on site is not suitable. Consultation with the USFWS New York State office website (listed species by county) revealed no endangered or threatened bird species were likely to be present on or near the Project site.

Based on the site visit and analysis of Breeding Bird Atlas (BBA) and Breeding Bird Survey (BBS) data, the Roaring Brook Project site has a diverse breeding bird community, composed mainly of woodland species. Noteworthy breeding birds include Wood Thrush and Canada

Warbler, both Green List (American Bird Conservancy) species that are relatively common in forest/woodland in the Tug Hill region. No federal or NYS endangered or threatened species are likely to breed at the Project site. Among NYS special-concern species, American Bittern, Sharp-shinned Hawk, Cooper's Hawk, Northern Goshawk, and Red-shouldered Hawk may nest on or adjacent to the Project. Spruce and fir were present, but not in stands large enough or dense enough for Bicknell's Thrush, which has been reported from the Tug Hill Plateau.

There are few or no major ecological magnets to attract or concentrate migratory birds in large numbers at the Project site or nearby. Nocturnal songbird, hawk, and waterbird migration will be broad front in nature and generally at high altitudes. However, wetland species such as bitterns and some others will visit the wetlands on site in relatively small numbers during migration.

Christmas Bird Count (CBC) data indicate that the Project site will have very few birds in winter, when cold temperatures and very deep snow severely limit foraging opportunities for birds. Of the listed species, the special-concern Northern Goshawk is perhaps the likeliest to occur, but it requires such large foraging territories that its frequency will be extremely low.

The Project site is within the Tug Hill Area IBA (Important Bird Area). It was selected as a site for *Responsibility Species Assemblages*. This criterion identifies sites with the most important habitats for assemblages of bird species whose long-term conservation is the responsibility of New York State. Sites meeting this criterion usually consist of large, intact areas that support all or most of the responsibility species in any one habitat-species assemblage. In this regard, the Tug Hill Area IBA supports a number of characteristic forest breeders, including the NYS special-concern American Bittern, Sharp-shinned Hawk, Northern Goshawk, and Bicknell's Thrush (also Green List), and the Green-List American Black Duck, American Woodcock, Wood Thrush, and Canada Warbler. The NYS threatened Bald Eagle has nested historically in the Tug Hill Area. Some of these species may nest within the Project site.

Regarding avian risk from the Roaring Brook Project, significant displacement effects are not anticipated. Because waterfowl, shorebirds, and herons do not concentrate at the Project site, displacement effects, if they were to occur, are unlikely to have a significant effect at a regional population level. With respect to raptors, some disturbance impacts may occur if wind turbines are constructed near nesting sites, although resident raptors generally habituate to wind farms after construction is complete.

Regarding forest birds, after the construction phase, forest-edge species will likelyhabituate to the presence of turbines. For some early successional species, Project construction may increase available habitat. For forest-interior species, particularly Wood Thrush (Green List), edge effect, resulting from habitat removal for access roads and turbine construction areas, could conceivably make a significant portion of the Project site less suitable. But, the areas where turbines are to be constructed have already been heavily logged and are crisscrossed by existing logging roads. If the site were undisturbed forest, displacement effects could be significant for certain species, but since the site is heavily logged, these effects should be much less. Management of the forest on site by the landowner in the future is crucial for preserving habitat for the species listed above.

Regarding collision risk, fatality numbers and species impacted at the Roaring Brook Project are

likely to be somewhat greater, on a per turbine per year basis, than found at other Eastern and Midwestern projects that have been studied. The reason is that the turbines would be nearly 30 m taller than most recently constructed turbines, including the nearby Maple Ridge project, thereby extending further into the height of night migration. These fatalities, when distributed among many species however, are not likely to be biologically significant. Few nesting birds, would likely collide with turbines with the possible rare exception of raptors. When compared with sites where significant collision mortality has been documented, such as the Altamont Pass Wind Resource Area, collision risk for raptors at the Roaring Brook site are minimal.

The following recommendations are designed to minimize avian risk:

- Electrical lines within the project site should be underground between the turbines. Any new aboveground lines from the site and substations to transmission lines should follow Avian Power Line Interaction Committee (APLIC) guidelines for insulation and spacing.

- Permanent meteorology towers should be freestanding (i.e., without guy wires) to prevent the potential for avian collisions.

- Utilize previously disturbed areas on site for turbine locations and other infrastructure.

- Size of roads and turbine pads should be minimized in order to disturb as little habitat as possible. This may be accomplished by consolidating road and interconnect routing. In addition, after construction, any forest habitat should be permitted or encouraged to regenerate as close to the turbines and roads as possible in order to minimize habitat fragmentation, edge effects, and disturbance/displacement impacts.

- A long-term forest management plan, including a sustainable harvest methods, involving the landowner is recommended. The plan could be modeled after that used by The Nature Conservancy on adjoining lands. Such a plan would reduce the potential of forest fragmentation and provide a means of preserving forest interior nesting species.

- Lighting of turbines and other infrastructure (turbines, substations, buildings) should be minimal in order to reduce the potential for attraction of night migrating songbirds and similar species. Federal Aviation Administration (FAA) lighting for night use should be flashing lights (red or white) with the longest permissible off cycle. No steady burning FAA lights should be used. Sodium vapor lamps and spotlights should not be used at any facility (e.g., lay-down areas or substations) at night except when emergency maintenance is needed.

- A nesting bird study is recommended as a means of determining species composition, the presence of Green List and other rare species, as well as providing a baseline for potential postconstruction studies of displacement impacts.

- A post-construction study of collision fatalities would provide information on the number and type of fatalities that occur, and determine the biological significance and potential for cumulative impacts of turbine development in New York State and the Eastern U.S.

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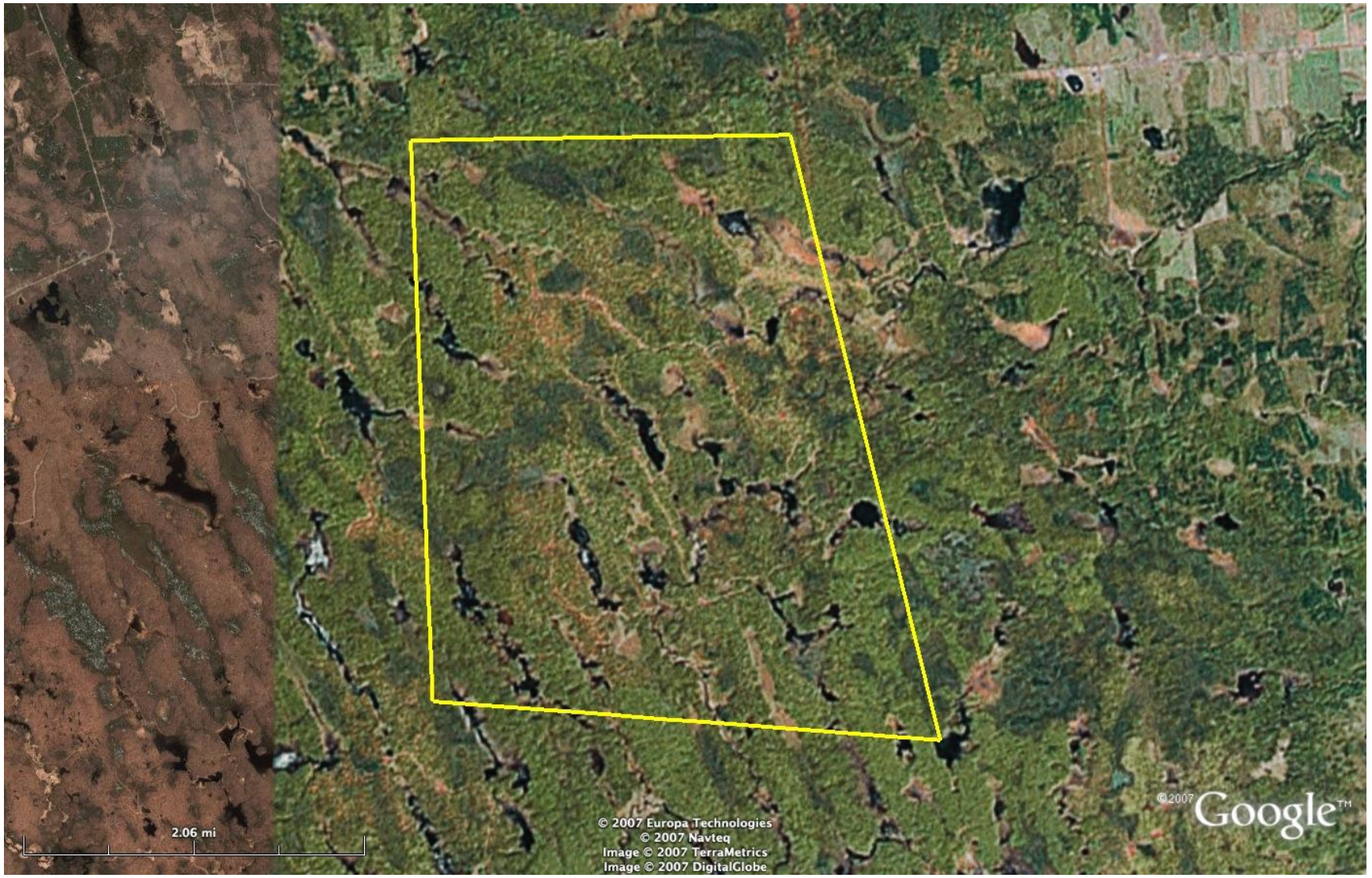

1.0 Introduction

PPM Energy has proposed a utility-scale wind-power project for a heavily logged, but wooded site on the Tug Hill Plateau in west-central Lewis County, New York. It plans to construct approximately 40 wind turbines, each with a nameplate capacity of 2.0 megawatts (MW), for a total project capacity of 80 MW at peak production. This report details a Phase I Avian Risk Assessment conducted for the Roaring Brook Wind Power Project (hereafter referred to as the "Project").

The purpose of a Phase I Avian Risk Assessment is to determine potential risk to birds from project construction and operation at a proposed site. Birds are generally at risk from: 1) collisions with turbine rotors and meteorology tower guy wires, and 2) displacement by construction activities and new, large infrastructure. The Phase I Avian Risk Assessment walks developers, regulators, environmentalists, and other stakeholders through a risk assessment process at a particular site, including how evaluation of potential impacts may require further study. The process is based on: 1) a site visit, 2) a literature and database search, and 3) written consultations with wildlife agencies regarding special-interest species, as well as other wildlife concerns. The Phase I also addresses compliance issues and recommendations set forth by the U.S. Fish and Wildlife Service (FWS) in its *Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines* (USFWS 2003; see Appendix A).

An avian expert skilled in bird identification and habitat evaluation undertakes the site visit. Over a two to three-day period, this researcher conducts a thorough tour of the site by car and on foot, noting the different bird habitats present and recording the birds seen or heard. The expert also documents the various habitats and landscape features with photographs. In the field, habitats and topography are evaluated with special consideration for: 1) federal and state-listed endangered, threatened, and other special-interest bird species; and 2) probable avian use during the nesting, migration, and winter seasons. The site visit is not intended to be an exhaustive inventory of species presence and use. Nonetheless, it adequately records habitat and topographic features so that a list of species that might conceivably be present at different times of the year can be assembled and the potential for risk to those birds from a wind power project can be assessed.

Avian literature and databases examined include records of the FWS and the New York State Department of Environmental Conservation (DEC), as well as data from the New York Breeding Bird Atlas (BBA; 2000-2005), North American Breeding Bird Survey (BBS), Audubon Christmas Bird Counts (CBC), hawk migration literature (e.g., Hawk Migration Association of North America), Important Bird Areas (IBA), and other information on birds that might nest, migrate, forage, winter, or concentrate at the site. An additional part of the literature search focuses on the empirical findings of studies that have focused on wind turbine impacts to birds.

Consultations are conducted via letter with wildlife agency biologists – in this case, FWS and DEC (by EDR) – to request information they may have on listed species at or near the Project site. These letters seek to improve knowledge of the site's avifauna and of the potential risk to birds that are likely to be present. Additionally, such consultations can determine the scope of

work that may be needed to further assess risk after the avian risk assessment has been completed.

Following the process outlined above, this report summarizes bird use of the Project site's habitats, compares the Project site with wind-energy projects where risk has been determined (with special consideration given to wind-power projects in the Eastern U.S.), determines the potential risks birds may face from the construction and operation of wind turbines at the site, and presents recommendations for further studies and mitigation, if indicated.

2.0 Project and Site Description

2.1 Project Description

The Roaring Brook Wind Power Project is proposed for a site in northwest New York State (see Figure 1), in the town of Martinsburg in west-central Lewis County (see Figure 2). The site is about 20 miles (32 km) southeast of Watertown.

PPM Energy, the Project proponent, has identified a wooded site on the Tug Hill Plateau roughly 3.5 miles (5.6 km) long by 3.0 miles (4.8 km) wide (10.5 mi^2 [26.9 km^2]) to construct the Project. It proposes 40 wind turbines, each with a nameplate capacity of 2.0 MW (total project capacity of 80 MW). The tower height of the wind turbines would be 100 m (328 feet), with a rotor diameter of 93 m (305 feet). Maximum height of the rotor tip when the rotor is in the 12 o'clock position would be 146.5 m (481 feet) above ground level (AGL). In the 6 o'clock position, the rotor tip could be as low as 53.5 m (175.5 feet) AGL.

Turbines would be mounted on tubular steel towers and all or a subset of them would be lit according to Federal Aviation Administration (FAA) guidelines. As with most modern wind farms, FAA lighting would probably be red strobe-like lights or newer LED's (FAA type L-864) on the nacelle at about 100 m (328 feet) above the ground. Most electrical collection lines within the Project area would be underground. An electric substation for the purpose of connecting the Project to the electric power grid might be constructed somewhere on the Project site, and/or adjacent to an existing transmission line, if an existing nearby substation is not suitable. The connection between the substation and existing transmission lines could be above ground.

2.2 Site Description

The New York State Atlas and Gazetteer (DeLorme 2003), satellite imagery viewable through Google Earth Pro, USGS topographic maps viewable through National Geographic's TOPO! mapping software, and various literature sources and Internet sites were consulted in order to understand the Project site's topography, physiography, and habitat. This information was checked against a site visit conducted by an avian researcher on May 22 and 23, 2007.

The Roaring Brook Project site is located in the Tug Hill region, an extensive, relatively unfragmented forested landscape located between Lake Ontario and the Adirondack Mountains. The region receives the heaviest snowfall in the eastern U.S. (visit www.tughill.org). Record snowfall totals have been recorded just west of the Project site, with a one-day record of 6.4 feet

(2.0 m) and a seasonal record of 39 feet (11.9 m) (visit http://en.wikipedia.org/wiki/Tug_Hill_Plateau).

Based on satellite imagery (see Figure 3), the Project site is a mosaic of mostly deciduous woodland, wetlands, ponds, and streams. The wetland habitats probably derive from the extreme amount of winter precipitation. The woodland at the project site is not homogenous. Many areas appear to have been deforested or intensively logged and are in early stages of secondary succession. The Project site is surrounded by forest/woodland. To the southeast, forest/woodland extends for as much as 20 miles (32 km). But, the site is only about 1.5 miles (2.4 km) from the agricultural lands dominating the eastern slope of the Tug Hill and the Black River valley to the east. The site is relatively flat, with elevations ranging from 1,870 to 1,970 feet (570 to 600 m), but it is high enough relative to surrounding topography to include the divide between three watersheds.

3.0 Results of Site Visit

The site of the proposed Roaring Brook Wind Power Project was visited on May 22 and 23, 2007. That site visit was conducted by Dave Tetlow, an experienced field biologist from Rochester, NY. Tetlow has worked as a Breeding Bird Atlas field technician for the NYS DEC in New York and Pennsylvania Game Commission and has done "block busting" in the Tug Hill Plateau forest. All areas accessible by road were toured by automobile, but most areas were walked. All proposed turbine areas were visited. Weather was seasonal, with cool mornings and warm afternoons and light to moderate winds out of the southwest. There was no rain.

Photographs in Appendix B show the major habitats and landscape features on site. The habitat was virtually identical at all sites and there are dirt roads that transect much of the site providing access for logging operations and recreation. The site may be described as a heavily logged with logging cuts throughout the entire complex often covered with brambles (*Rubus sp*.). The forest is almost entirely second-growth mostly deciduous woodland with interspersed wetlands, ponds, and streams. Trees were generally spindly in form, about 30 to 40 feet (9 to 12 m) in height. Logging roads were present throughout, but many were not passable because of thick growths of brambles. The dominant trees were sugar maple, black birch, American beech, and cherry with some balsam fir, red spruce (possibly some black spruce in wet areas), The understory was relatively sparse, with *Vibernum sp.* and *Rubus sp*. being two of the dominant plants along with striped maple, and *Amelanchier sp*., among other species.
The site visit recorded 68 bird species (see Appendix C), most of which were woodland birds. Despite the many wetlands and ponds, waterbird diversity was limited to Canada Goose, Wood Duck, American Bittern (NYS special concern), Great Blue Heron, Green Heron, and Spotted Sandpiper. Among raptors, only Turkey Vulture (not technically a raptor, but often listed as such) was recorded.

Of the special-interest species, only the NYS special-concern American Bittern was recorded, when one bird was heard calling from a wetland.

4.0 Avian Overview of the Roaring Brook Wind Power Project Site

The North American Landbird Conservation Plan (Rich et al. 2004) locates the Roaring Brook Project site in the Atlantic Northern Forest Region (Bird Conservation Region # 14) of the Northern Forest Avifaunal Biome, a region covering much of northern North America.

Based on information in the document, *DRAFT: Blueprint for the Design and Delivery of Bird Conservation in the Atlantic Northern Forest* (Dettmers, in preparation; visit http://www.acjv.org/documents/bcr14_blueprint.pdf), Northern Hardwood forest is the forest type covering the Tug Hill region. The dominant trees of this association are beech, birch, and maple species. Its characteristic birds include Ruffed Grouse, Yellow-bellied Sapsucker, Blue-headed Vireo, Wood Thrush, Veery, Black-throated Blue Warbler, American Redstart, Overbird, and Rose-breasted Grosbeak. Where this forest type has been logged or disturbed, the resulting early successional/shrubland habitats contain such characteristic birds as American Woodcock, Ruffed Grouse, Chestnut-sided Warbler, Tennessee Warbler, Mourning Warbler, and Whip-poor-will. Where wetland habitats occur, characteristic birds include American Black Duck, Wood Duck, Common Loon, American Bittern, Bald Eagle, and Spotted Sandpiper.

Bird conservation issues in the Atlantic Northern Forest (see Dettmer, in preparation) revolve around balancing forest management for timber production with the maintenance of forest successional stages. In the southwestern portion of the Atlantic Northern Forest region, including the Tug Hill region, declines in the availability of early successional forest habitats are of particular concern. Other concerns include forest health issues, resulting mainly the spread of various invasive forest pest species and atmospheric deposition of toxic substances (such as mercury and acid rain), the latter resulting mainly from fossil fuel-based electricity generation. Wind-power development along forested ridgelines has also been flagged as a concern, as has urban sprawl and recreational development.

According to Rich et al. (2004), the Northern Forest Avifaunal Biome is a core breeding range for Neotropical migrants, particularly warblers, thrushes, vireos, and flycatchers. About 90% of the birds that breed in this region migrate out for the winter, with some wintering as far south as northern South America. Between 121 and 150 landbird species are recorded as breeding in the various habitats of the Northern Forest region of the Adirondacks and Tug Hill, but only between 41 and 80 landbird species occur there in winter (Rich et al. 2004).

A seasonal look at the avifauna at the Roaring Brook Project site follows.

Table 4.1-1. Listed Species and Habitat Suitability for Nesting

Species[5]	NYS (Federal) Status[1]	Recorded Site Visit?	Recorded BBA Block?[2]	Recorded BBS Route?[3]	Habitat Suitability at Site?[4]
Spruce Grouse	E				NS
Golden Eagle	E				NS
Peregrine Falcon	E				NS
Black Rail*	E				NS
Piping Plover*	E (US-E)				NS
Eskimo Curlew*	E (US-E)				NS
Roseate Tern*	E (US-E)				NS
Black Tern	E				NS
Short-eared Owl*	E				NS
Loggerhead Shrike	E				NS
Pied-billed Grebe	T				NS
Least Bittern	T				NS
Bald Eagle	T (US-D				NS
Northern Harrier	T			+	MS?
King Rail*	T				NS
Upland Sandpiper*	T			+	NS
Common Tern	T				NS
Least Tern*	T				NS
Sedge Wren	T				NS
Henslow's Sparrow*	T				NS
Common Loon	SC				NS
American Bittern	SC	+	+	+	S
Osprey	SC				NS
Sharp-shinned Hawk	SC		+		S
Cooper's Hawk	SC			+	S
Northern Goshawk	SC		+		S
Red-shouldered Hawk	SC		+		S
Black Skimmer	SC				NS
Common Nighthawk	SC				NS
Whip-poor-will	SC				NS
Red-headed Woodpecker*	SC				NS
Horned Lark	SC			+	NS
Bicknell's Thrush*	SC			?	NS
Golden-winged Warbler*	SC				NS
Cerulean Warbler*	SC			+	NS
Yellow-breasted Chat	SC				NS
Vesper Sparrow	SC				NS
Grasshopper Sparrow	SC				NS
Seaside Sparrow*	SC				NS

[1] E = Endangered, T = Threatened, D = Delisted, SC = Special Concern; see http://www.dec.ny.gov/animals/7494.html

[2] BBA = Breeding Bird Atlas. See Table 4.1.1-1 for details.

[3] BBS = Breeding Bird Survey. See Table 4.1.2-1 for details.

[4] S = Suitable, MS = Marginally Suitable, NS = Not Suitable, and ? = uncertainty in evaluation.

[5] * = ABC Green List; see Section 4.1 discussion.

4.1 Breeding Birds

Table 4.1-1 summarizes the DEC and FWS lists of endangered, threatened, and special-concern species. Given their special status, these species have been given particular attention in assessing avian risk at the Project site. Based on the site visit and other data sources, Table 4.1-1 also grades the suitability of habitat for nesting on the Project site as suitable (S), marginally suitable (MS), or not suitable (NS). Where there is uncertainty in this assessment, it is indicated by a question mark.

An examination of the USFWS website for New York State revealed no endangered or threatened bird species were likely to be present within Lewis County. Similarly, a letter from the NYSDEC Natural Heritage Program (Appendix D) listed no endangered or threatened species for the Project site. The latter agency did however, list Bay-breasted Warbler, Three-toed Woodpecker, and Clay-colored Sparrow, all "Rare Species" in New York State, as being present at sites within a few miles of the Roaring Brook site. However, none are likely to be found on site, based on their habitat requirements (spruce-fir forest, spruce bog forest, and old-field with some trees), which are not present within the project boundary.

It is worth noting that some species likely to occur on site (listed and not listed in Table 4.1-1) are also on the American Bird Conservancy (ABC) Green List. The Green List contains all the highest priority birds for conservation in the continental United States and Canada. It is based on the species assessments that Partners in Flight (PIF; see Rich et al. 2002) has conducted for landbirds, but ABC has taken PIF's standards and applied them to other bird groups.

The Green List is divided into three categories: 1) *Highest Continental Concern* (38 species, including Black Rail, King Rail, Piping Plover, Eskimo Curlew, Bicknell's Thrush, Golden-winged Warbler, and Henslow's Sparrow on the NYS list); 2) *Moderately Abundant Species with Declining Populations or High Threats* (70 species, including Upland Sandpiper, Roseate Tern, Least Tern, Short-eared Owl, and Cerulean Warbler on the NYS list); and 3) *Species with Restricted Distributions and Low Population Size* (79 species, including Seaside Sparrow on the NYS list).

Among the species in second category, *Moderately Abundant Species with Declining Populations or High Threats*, some not listed in Table 4.1-1 also occur at the Project site. Examples from the site visit are Wood Thrush and Canada Warbler. The occurrence of any Green List species will be highlighted in the various data sources checked below.

In the following sections, two data sources will be examined to determine the likely breeding bird community in and around the Roaring Brook Project site. One is the 2000-2005 NYS

Breeding Bird Atlas (BBA; see http://www.dec.ny.gov/animals/7312.html), because its recent coverage overlapped the Project site. It was checked for the occurrence of listed species. The other source is the last ten years of data from nearby routes of the Breeding Bird Surveys (BBS) of the U.S. Geological Survey (USGS). One of these routes was analyzed in detail in order to profile the breeding bird community. Green List species indicated in these analyses are noted.

4.1.1 Breeding Bird Atlas (BBA) Analysis

The Breeding Bird Atlas (BBA) was a comprehensive, statewide survey that revealed the current distribution of breeding birds in New York State. New York's first BBA was conducted in 1980-1985 and reported in the 1988 publication, *The Atlas of Breeding Birds in New York State* edited by Robert F. Andrle and Janet R. Carroll. In 2000-2005, this effort was repeated in order to determine what changes have occurred in breeding bird distribution. The results of the recent survey are available on the Internet (see http://www.dec.ny.gov/animals/7312.html).

The BBA project divided the entire state into ten regions (the Project site is in Region 6) and 5,335 blocks, each of which measured 5 x 5 km (3 x 3 miles). Each block was designated as A, B, C, or D, with A blocks in general given the most importance, in the event volunteers did not have enough time to survey all of the blocks. Blocks were assigned to volunteer birdwatchers who, with detailed topographic maps, visited the various habitats within their assigned blocks in order to record evidence of breeding for the birds they saw. Evidence of breeding was graded as *Possible* (i.e., a species is simply observed in possible nesting habitat), *Probable* (i.e., a species exhibits certain behaviors that indicate breeding, such as territoriality, courtship and display, or nest building), or *Confirmed* (i.e., a species is observed nesting or engaged in behaviors associated with nesting, such as distraction display, carrying a fecal sac, carrying food for young, etc.).

Four blocks covered portions of the Roaring Brook Project site and adjacent areas. All were surveyed during the 2000-2005 Atlas Project (see Table 4.1.1-1). The species totals for the blocks were relatively high, ranging from 94 to 79 species. This indicates a high level of effort in covering the blocks.

Table 4.1.1-1. Listed Species Records in 2000-2005 BBA

Block	Total Species	Listed Species[1]	Breeding Status
4483A	94	American Bittern (SC)	Probable
		Sharp-shinned Hawk (SC)	Confirmed
		Northern Goshawk (SC)	Confirmed
		Red-shouldered Hawk (SC)	Confirmed
4483B	87	American Bittern (SC)	Probable
		Northern Goshawk (SC)	Possible
4484C	79	Northern Goshawk (SC)	Confirmed
		Red-shouldered Hawk (SC)	Confirmed
4484D	83	Sharp-shinned Hawk (SC)	Possible

[1] See Table 4.1-1.

As can be noted in Table 4.1.1-1, no endangered or threatened species were recorded in the four overlapping blocks, but four special-concern species were: American Bittern (probable breeder), Sharp-shinned Hawk (confirmed breeder), Northern Goshawk (confirmed breeder), and Red-shouldered Hawk (confirmed breeder).

Based on a perusal of the species distribution maps resulting from the 2000-2005 BBA, the only other listed species recorded in the Project site's proximity were the threatened Northern Harrier and Upland Sandpiper and special-concern Cooper's Hawk, Horned Lark, and Vesper Sparrow. Their distributions appear to coincide with the agricultural lands of the Black River valley, to the east of the Project site. Cooper's Hawk could conceivably nest in the Project site's woodland. While Northern Harrier could possibly nest in marshy wetlands, the ones at the Project site are probably not large enough. Upland Sandpiper, Horned Lark, and Vesper Sparrow require agricultural habitats and grasslands, which are entirely lacking at the Project site.

The following Green List species were recorded in the BBA blocks that overlapped the Project site: American Black Duck (in 2 of 4 blocks, probable breeder), American Woodcock (in 4 of 4 blocks, confirmed breeder), Olive-sided Flycatcher (in 3 of 4 blocks, probable breeder), Wood Thrush (in 3 of 4 blocks, probable breeder), and Canada Warbler (in 3 of 4 blocks, probable breeder).

4.1.2 Breeding Bird Survey (BBS) Analysis

Now overseen by the Patuxent Wildlife Research Center of the U.S. Geological Survey (USGS), the North American Breeding Bird Survey (BBS) is a long-term, large-scale, international avian monitoring program that tracks the status and trends of North American bird populations. Each year during the height of the breeding season (normally June), mainly volunteer participants skilled in avian identification collect bird population data along roadside survey routes. Each survey route is 24.5 miles (39.4 km) long with stops at 0.5 mile (0.8 km) intervals, for a total of 50 stops. At each stop, a three-minute point count is conducted. The total survey time over the entire route, therefore, is 2.5 hours. At each point count, every bird seen within a 0.25 mile (0.4 km) radius or heard is recorded. Surveys start one-half hour before local sunrise and take about five hours to complete. Surveys are sometimes repeated several times each spring during the nesting season.

Two BBS routes are located in the vicinity of the Project site (see Table 4.1.2-2). The closest of these routes – Highmarket – was analyzed closely to characterize the breeding bird community in the Project region and to evaluate the likelihood of breeding by listed species. This route surveyed both forested and agricultural areas in the Project vicinity.

In order to profile the breeding bird community, Appendix E has been prepared. It lists the species recorded at least once during the last ten years on the Highmarket route. Species are listed both in taxonomic order and in order of their average frequency. To calculate average frequency, the average number of birds per year over the ten-year period was divided by the total survey time of 2.5 hours. This measure indicates which birds are likeliest to be found in habitats at the Project site.

4.1.2-1. Breeding Bird Survey (BBS) Records, 1996-2005

Route Number	Route Name	County	Distance/ Bearing from Site	Years Analyzed	Species Max-Min	Listed Species[1]	# Years Recorded	# Birds per Year
61076	Highmarket	Lewis	5 mi E	8	44-77	Northern Harrier (T)	4	1-4
						Upland Sandpiper (T)	1	1
						American Bittern (SC)	1	1
						Cooper's Hawk (SC)	1	1
						Horned Lark (SC)	6	3-9
						Bicknell's Thrush? (SC)	1	1
						Cerulean Warbler (SC)	1	2
61077	Number Four	Lewis	7 mi E	3	52-60	Northern Harrier (T)	1	1

[1] See Table 4.1-1

One hundred thirteen species were recorded on the Highmarket BBS route over the last ten years, of which four were recorded above 10 birds/hr and can be considered very common. They were:

Red-winged Blackbird	15.05	Song Sparrow	10.55
American Robin	12.15	Chestnut-sided Warbler	10.40

Thirty-nine species were recorded between 1 and 10 birds/hr and can be considered common. They included two Green List species, Wood Thrush and Canada Warbler. The complete list is as follows:

American Goldfinch	9.05	Wild Turkey	2.30
Red-eyed Vireo	8.75	Purple Finch	2.20
Common Yellowthroat	8.30	Eastern Meadowlark	2.05
European Starling	7.00	Rock Pigeon	1.90
Barn Swallow	6.60	Yellow Warbler	1.90
Bobolink	6.50	American Redstart	1.80
White-throated Sparrow	6.00	Winter Wren	1.70
Tree Swallow	5.30	Black-throated Blue Warbler	1.65
Ovenbird	4.85	Blue-headed Vireo	1.60
Wood Thrush*	4.50	House Sparrow	1.60
Savannah Sparrow	4.50	Swamp Sparrow	1.55
American Crow	3.85	Canada Warbler*	1.50
Alder Flycatcher	2.85	Eastern Kingbird	1.45
Common Grackle	2.85	Gray Catbird	1.35
Cedar Waxwing	2.75	House Wren	1.25
Mourning Dove	2.70	Blue Jay	1.20
Veery	2.70	**Horned Lark (SC)**	**1.20**
Black-throated Green Warbler	2.65	Nashville Warbler	1.15
Chipping Sparrow	2.45	Mourning Warbler	1.05
Killdeer	2.35		

Together, individuals of these 43 species made up 90% of the birds recorded on the BBS route. Birds of agricultural habitats were well represented, including Bobolink (6.50), Savannah Sparrow (4.50), Killdeer (2.35), Eastern Meadowlark (2.05), and Horned Lark (NYS special concern, 1.20). As the Project site lacks agricultural habitats, these birds are unlikely to frequent the site.

Woodland birds are also well represented among the common species, including Chestnut-sided Warbler (10.40), Ovenbird (4.85), Wood Thrush (Green List, 4.50), Veery (2.70), Black-throated Green Warbler (2.65), Purple Finch (2.20), American Redstart (1.80), Winter Wren (1.70), Black-throated Blue Warbler (1.65), Blue-headed Vireo (1.60), Canada Warbler (Green List, 1.50), Nashville Warbler (1.15), and Mourning Warbler (1.05).

Seventy species were recorded below 1 bird/hr and can be considered uncommon to rare species (see Appendix E). Among them were the NYS threatened Northern Harrier (0.40) and Upland Sandpiper (Green List, 0.05), and the NYS special-concern Cerulean Warbler (Green List, 0.10), American Bittern (0.05), and Cooper's Hawk (0.05). A Gray-cheeked Thrush (0.05) was also recorded, possibly Bicknell's Thrush, a NYS special-concern species (also Green List).

According to Dettmer (in preparation; see above), Bicknell's Thrush may nest in industrial forest landscapes. Nevertheless, as these data demonstrate, it is at best a rare bird in the Tug Hill region.

Waterbirds were not well represented on the Highmarket BBS route, either in terms of diversity (10 species, not including Killdeer and Upland Sandpiper) or frequency (Mallard highest at 0.60 birds/hr). Raptors were also not well represented, with only six species recorded, all at fairly low frequency: Turkey Vulture (0.65), Northern Harrier (NYS threatened, 0.40), American Kestrel (0.10), Cooper's Hawk (NYS special concern, 0.05), Broad-winged Hawk (0.05), and Red-tailed Hawk (0.05).

As noted above, birds of agricultural and wooded habitats were well represented.

Listed species records on the two nearby BBS routes are recorded in Table 4.1.2-1. Only the NYS threatened Northern Harrier was recorded on both routes. Only it and the NYS special-concern Horned Lark were recorded in more than one year. These species may be considered uncommon in the Project region, and they are largely confined to agricultural landscapes. All the other listed species were rare.

Regarding Green List species, the following were recorded on the Highmarket route: Wood Thrush (4.50), Canada Warbler (1.50), American Woodcock (0.20), Cerulean Warbler (0.10), Worm-eating Warbler (0.10), Upland Sandpiper (0.05), and Bicknell's Thrush (0.05, if it was indeed this species). Only two of these species were relatively common, indicating that the Tug Hill region is a stronghold for them. Only Wood Thrush was recorded on the other BBS route, at 1.20 birds/hr.

4.1.3 Breeding Birds, Conclusions

Based on the site visit and analysis of BBA and BBS data, the Roaring Brook Project site has a diverse breeding bird community, composed mainly of woodland species. Noteworthy breeding birds will include Wood Thrush and Canada Warbler, both Green List species that are relatively common in woodlands in the Tug Hill region. No NYS listed endangered or threatened species are likely to breed at the Project site. Among NYS special-concern species, American Bittern, Sharp-shinned Hawk, Cooper's Hawk, Northern Goshawk, and Red-shouldered Hawk may breed at the site, but they would do so in low abundance.

4.2 Migratory Birds

This section sheds light on how migratory birds are likely to use the Roaring Brook Project site and its airspace. Because bird migration is a complex phenomenon, this report will look at the major migratory bird groups separately. These groups are nocturnal songbirds, raptors, and waterbirds (waterfowl, shorebirds, and others).

4.2.1 Nocturnal Songbird Migration

Nocturnal songbirds and allies are the most numerous of birds migrating over New York State. Species include cuckoos, woodpeckers, flycatchers, vireos, nuthatches, wrens, kinglets, gnatcatchers, thrushes, catbirds, thrashers, warblers, tanagers, and sparrows. Based on the population estimates provided in Rich et al. (2004) for Northern Forest breeding birds, migratory songbird traffic above New York State is probably on the order of hundreds of millions of birds per season. In New York State, nocturnal songbird migration is concentrated from late April to mid and late May (spring migration) and from mid August into November (fall migration). Nocturnal migration also occurs in waves associated with meteorological phenomena. For example, during fall migration, numbers of southbound migrants are greater after the passage of cold fronts with their northwest winds (Kerlinger 1995). Studies using radar, ceilometers, and direct observation have shown that nocturnal migration is initiated thirty minutes to an hour after sunset. Peak nocturnal migration occurs from an hour after sunset until after midnight. Most birds land by sunrise (Kerlinger 1995).

General surveys on migration (Berthold 2001, Alerstam 1993, Eastwood 1967) strongly indicate that, if the nocturnal migration of individual songbirds over New York State could be plotted on a map, the resulting pattern of parallel movement would cover the entire state evenly. In the fall, this pattern would be oriented in a south-southwesterly direction. In the spring, the direction would be north-northeasterly. This is the pattern of a “broad-front” migration. Berthold (2001) went so far as to say, “individuals originating from geographically dispersed breeding areas cross all geomorphological features (lowlands, mountains, rivers, and so on) along their routes without deviating much from the orientation of their initial tracks.”

Radar studies conducted in the Eastern U.S. indicate that the night migration of songbirds, shorebirds, waterfowl and others is broad-front as opposed to concentrated in narrow corridors or at topographic features (Cooper et al. 1995, Cooper and Mabee 1999, Cooper et al. 2004b, 2004c). Perhaps the best evidence to support the contention that birds do not follow topographic features in the Eastern U.S. is a study by Cooper et al. (2004a) from a ridge in West Virginia, and a comparison of radar studies on ridges in southwestern Pennsylvania, Maryland, and West Virginia (Kerlinger 2005). These studies showed that night migrants simply cross the southwest-northeast-oriented ridges of the Appalachians at oblique angles rather than following them. These same birds were not concentrated in large numbers on the ridges, nor were they flying at low altitudes that would suggest ridge following. These findings are consistent with the phenomenon of broad-front migration and would appear to refute a ridge-following hypothesis.

Even migrants confronted by the Great Lakes do not turn when they reach the lake shores during night migration (Diehl and Larkin 2003). Instead, they continue to cross the lakes as if they were

not present. These birds do, however, put down for stopovers in habitats close to the lakeshores, especially in the hours before dawn. Nonetheless, the evidence is overwhelming that most night migrating songbirds are spread across a broad front over most types of topography encountered by these birds. There are no lakeshores, mountain ranges, or other physiographic features near the Roaring Brook Project site that would concentrate migrants making stopovers.

Kerlinger, J. Plissner, and others (in preparation) has reviewed marine surveillance radar studies conducted at about 20 sites in the eastern U.S. These sites were distributed in western Maine (1), Vermont (2), northern (5) and western (3) New York (including studies from the Tug Hill Plateau adjacent to the Project site), southwestern Pennsylvania (3), western Maryland (1), eastern West Virginia (2), and western Virginia (1). Sites were studied in the spring, fall, or in both seasons. The number of sites studied in the spring (11) was fewer than those studied in the fall (17).

The amount of migration at all sites, in terms of numbers of birds passing through a one kilometer corridor during one hour (targets/km/hr, the standard of measurement), ranged from 135 to 661 targets/km/hr in the fall and from 42 to 473 targets/km/hr in the spring. It is important to note that these are mean seasonal rates. Within each season, there was significant variation from night to night.

While migration traffic rates at eastern U.S. sites appear to range widely, comparisons with radar study sites in the southeastern U.S. provide a dramatic perspective. Mean seasonal migration rates from Louisiana, Georgia, and South Carolina were in the thousands of birds per kilometer per hour in both fall and spring. Traffic rates in Louisiana averaged 9,000 to 10,000 targets/km/hr during fall, with some nights having on the order of 30,000-plus targets/km/hr. In spring, these sites registered flights averaging 3,000 to 50,000 targets/km/hr (Able and Gauthreaux 1975, Gauthreaux 1971, 1972, 1980). Similar, but slightly lower, migration traffic rates were reported by Able and Gauthreaux (1975) and Gauthreaux (1972, 1980) at a site near Athens, Georgia, and at a site in South Carolina. In Georgia during fall, the rate was between 1,500 and 3,250 targets/km/hr, and at both sites there were nights with tens of thousands of birds per kilometer per hour passing overhead.

In other words, migration traffic over the northeastern U.S. is low to moderate when compared with the Gulf Coast and southern U.S. region, where birds are concentrated before or after crossing the formidable ecological barrier presented by the Gulf of Mexico.

Mean migration altitude at the 18 eastern U.S. sites surveyed ranged from 148 m (485 feet) to 583 m (1,912 feet) AGL (Above Ground Level) in the fall, and from 130 m (426 feet) and 528 m (1,732 feet) AGL in the spring. But, if radar measurements prior to 2000 are excluded, the range of mean altitudes for the sites in fall was 365 m to 583 m (1,197-1,912 feet) AGL. For sites in the spring, it was 401 m to 528 m (1,315-1,732 feet) AGL. This exclusion is important because the less powerful radar employed prior to 2000 was biased toward lower flying birds.

Another measurement routinely made by radar operators is the percentage of migrants below 125 m (~410 feet). This measurement is approximately equal to the height of most wind turbines now being installed in the United States and is used to determine the potential for risk, although

it has never been validated empirically as an indicator of the numbers of fatalities of night migrants at turbine sites. Excluding pre-2000 data, the fall percentage of migrants that fly below 125 m ranges from less than 4% of all migrants tracked with radar to about 13-20%. In spring, the percentage ranges between 4% and 12%. This means that between about 4% and 13% of migrants fly within the height of most modern wind turbine rotors. A slightly greater percentage will be found flying within the rotor swept height (146.4 m [481 feet]) at the Roaring Brook site because the turbines there will be about 25% taller than other turbines now being erected.

From the mean altitudes reported above, it is clear that most migration occurs well above the rotor-swept height of turbines. These measurements are consistent with the mean altitude of nocturnal migrants reported by several authors who have reviewed radar studies from other parts of the United States, Canada, and Europe (Kerlinger 1995, Kerlinger and Moore 1989; Able 1970). These measurements are also similar to measurements from the southeastern United States taken with weather radar. From these studies, it does not appear that there is a great difference with respect to altitude of night migrating birds in diverse geographic settings or diverse topographies. This should also be the case in the Tug Hill region.

Flight direction of migrants tracked with radar in the eastern U.S. did not vary greatly among sites. The numerical means of the mean directions reported for fall and spring migration were 190° in fall and 38° in spring. These correspond to south-southwesterly migration in fall and northeasterly migration in spring. The standard deviations (actually angular deviations using circle-based statistics) around each site in the eastern United States is in the range of 40 to 80°. In other words, about 75% of all migrants tracked within 40° to 80° of the mean direction of migration. What is noteworthy is that in fall the mean migration directions reported from all of the eastern sites range between 219° and 175°, a range of 44°. The mean migration direction at sites in western New York was almost identical to migration directions near the Adirondacks, Maine, and even Maryland, Virginia, and West Virginia. There is no apparent pattern for the minor variation in flight directions.

Young and Erickson (2006) have also reviewed radar studies at proposed and existing wind-energy projects in the Eastern U.S. (see NRC 2007). Based on 21 studies, they found similar mean passage rates in spring and fall (258 versus 247 targets/km/hr, respectively). Mean height of flight was 409 m AGL in spring and 470 m AGL in fall, with 14% of targets below 125 m (410 feet) in spring and 6.5% below that height in fall. Mean flight directions were NNE (31 degrees) in spring and SSW (193 degrees) in fall. These averages are in line with Kerlinger's analysis.

In summary, nocturnal songbird migration above the Roaring Brook Project site will be broad front in nature. Given that the site is located away from lakeshores and other ecological barriers that tend to concentrate nocturnal migrants during fallout events, it is likely that migration traffic above the site should be similar to migration traffic determined by radar studies at eastern U.S. sites. These birds generally fly above the height of wind turbine rotors, but a percentage of birds will fly in the rotor-height zone.

4.2.2 Hawk Migration

Hawk migration throughout New York State has been well documented (including by one of this report's authors, who did his doctoral and other research on this phenomenon in east-central New York between 1975 and 1981). Since the boom of recreational birdwatching in the 1960s, thousands of birdwatchers have searched the state to locate migration corridors for raptors. Annually, thousands of these birdwatchers visit dozens of sites throughout the state to watch and count migrating hawks. It is safe to say that most of the localities where large numbers of hawks occur during migration are known.

The Hawk Migration Association of North America (HMANA, http://www.hmana.org) lists 43 hawk watch sites in New York State, of which 14 are significant enough to report results to hawkcount.org, a database on hawk numbers. Overall, at the significant sites, migrating hawks can reliably be seen in impressive numbers of up to tens of thousands of birds during the migration season. In New York State, the best hawk watching sites are located either in the far southeastern corner of the state in the lower Hudson Valley and on Long Island, or along the southern shore of Lake Ontario (Derby Hill, Braddock Bay) and Lake Erie (Ripley).

According to HMANA, the Tug Hill region is located in the "Central Continental Flyway Region," despite its location in the eastern United States. In this "flyway," the significant hawk migration points, where birds congregate in large numbers (thousands to, sometimes, tens of thousands daily), are located within the Great Lakes region, mostly along the edges of the lakes. Rather than crossing these large expanses of water, hawks usually fly around them, in close proximity to the shorelines until they can proceed in the desired direction (north in the spring, and south in the fall). In the absence of water barriers, or ridgelines creating updrafts, hawk migration in the Central Continental Flyway takes place over a broad front and regularly occurring flight lines are difficult to identify. Sufficiently far from Lake Ontario and lacking prominent ridgelines, the area where the Project is located can be expected to lack significant concentrations of migrating hawks.

Based on information provided in available databases and publications (http://www.hmana.org, Zalles and Bildstein 2000), no New York hawk watches are located in the vicinity of the Project site. The closest significant site to the Roaring Brook Project site is the Derby Hill hawk watch, about 32 miles (51 km) west-southwest of the proposed Project. Tens of thousands of hawks pass Derby Hill during the spring migration as they concentrate along the shore of Lake Ontario (during the fall migration, relatively few hawks pass Derby Hill). Most of the migration noted at Derby Hill is concentrated within 1 to 5 miles (1.6 to 8 km) of the lakefront. Inland, migrating hawks are spread more evenly over large areas.

In summary, above the Project site, hawk migration can be expected to be broad front in nature, as there are no lakeshores or ridgelines to concentrate traffic. Studies have shown that the migration altitudes of hawks generally range from 600 up to 1,500 feet (200 to 450 m) or even higher at midmorning, and up to altitudes up to 3,500 to 4,000 feet (1,100 to 1,200 m) or higher by mid-afternoon, when rising columns of air (thermals) reach their maximum (Kerlinger 1989).

4.2.3 Waterbird Migration

In his maps of waterfowl migration corridors, Bellrose (1980) shows between 151,000 and 300,000 geese migrating over the Tug Hill region between Hudson Bay and Chesapeake Bay. Duck migration between the Prairie Pothole region and Long Island Sound and southern New England is bracketed at 50,000 and 225,000. In the Project vicinity, there are no large lakes, marshes, mudflats, or other types of ecological magnets that would attract waterbirds, including ducks, rails, shorebirds, and the like in significant numbers. In this regard, the Project site is about 15 miles (24 km) from Oneida Lake and about 30 miles (48 km) from Lake Ontario, two water bodies where waterfowl are know to concentrate.

The site visit documented marshes, ponds, and streams within the Project limits, but the Project site is not unique in this respect. Based on satellite imagery, all forested areas of the Tug Hill region appear to contain these habitats, the result probably of the exceptional winter precipitation. Therefore, waterbirds that use these habitats in migration will be spread throughout the landscape, not concentrated in any one area.

Regarding other types of waterbirds, the Project site is not located near sites where shorebirds, wading birds, gulls or terns are known to congregate.

Aviation reports from the Midwest indicate that most Canada Geese fly at about 2,000 feet above the ground in fall, with 52% of flocks between 1,000 and 3,000 feet and some flocks as low as 500 feet and others as high as 11,000 feet; spring aviation records show the average altitude even higher, at 2,500 feet (Bellrose 1980). Most migration of waterfowl and other waterbirds takes place at night, but some extends to daylight hours, depending on the distance traveled. Radar studies show altitudes of 500 to 1,000 feet (152 to 304 m) or more at many locations for ducks, geese, loons, and other birds (Kerlinger 1982, Kerlinger 1995, reviewed by Kerlinger and Moore 1989). It should be noted that migrating geese do make stopovers to feed in corn and other seeds in agricultural fields during fall and spring migration. While agricultural fields are present nearby in the Black River valley, none are within 1.5 miles (2.4 km) of the Project site.

4.2.4 Migratory Birds, Conclusions

There are no ecological magnets (Berthold 2001, Alerstam 1990) that would attract or concentrate migratory birds in large numbers at the Project site or nearby. In all cases, migration will be broad front in nature and generally at altitudes above the sweep of the wind turbine rotors.

4.3 Wintering Birds

Beginning in mid-November and extending into mid-late March, winter in northern New York is generally harsh, variable, and relatively inhospitable for most birds. The Project site is subject to strong northwest winds, low temperatures, and remarkably deep snow. Food for most birds, especially woodland birds, is likely to be scarce. Overall, during winter, a low diversity and density of birds would be expected in and around the Project site.

Audubon's Christmas Bird Count (CBC) provides an excellent overview of the birds that inhabit an area or region during early winter. Counts take place on a single day during a three-week period around Christmas, when dozens of birdwatchers comb a 15-mile (24 km) diameter circle in order to tally up all the bird species and individuals they see. In preparation for count day, participants also scout for birds during the "count week" period. While most of these birdwatchers are unpaid amateurs, they are usually proficient or highly skilled observers.

Available at http://audubon2.org/birds/cbc/hr/count_table.html, CBC data are used by scientists, wildlife agencies, and environmental groups to monitor bird populations. The results over the last ten years for the two CBCs closest to the Project sites (see Table 4.3-1) were examined in order to understand the winter bird populations likely to occur at these sites. All CBC's survey an area of about 177 square miles (453 km^2); thus, the CBCs considered in this report covered a total area of 354 square miles (906 km^2). Observer participation per count during the analysis period varied from a minimum of 8 observers to a maximum of 16.

The number of species recorded in these counts ranged from a maximum of between 43 and 64 species to a minimum of between 30 and 44 species. The coverage of the Watertown CBC circle included significant open water habitat on Lake Ontario. As a result, this count recorded numerous waterfowl species and various other waterbirds. Because the Project area does not front a major water body, and any open water or marsh would likely be frozen in winter, it would be expected to have fewer species than the Watertown CBC.

Table 4.3-1. CBCs Analyzed, 1997-2006

Count Name (Code)	Center County/ Province	Distance/ Bearing from Site	Years Analyzed	Number Participants	Number Species Min/Max
New Boston (NYNB)	Lewis	0 mi NW	8	8-14	30-43
Watertown (NYWA)	Jefferson	19.5 mi NW	10	10-16	44-64

To understand winter bird frequency at the Project site, Appendix F has been prepared. Sorted in taxonomic and frequency orders, this table displays the average frequency of birds, measured in birds/hr, for the nearby New Boston CBC, which overlaps a portion of the Project site. Yearly frequencies for species were determined by dividing the number of individuals by the total number of party hours. These values were then averaged using the last ten years of available data (1997 to 2006).

A total of 57 species were recorded on the New Boston CBC over the last ten years. Of these birds, only 10 species were recorded above 1 bird/hr and can be considered common.

Individuals of these species made up nearly 85% of all individuals recorded on the count. They were:

European Starling	9.56	Wild Turkey	2.58
Black-capped Chickadee	8.83	American Crow	2.53
Blue Jay	5.19	Common Redpoll	2.04
Rock Pigeon	3.83	Snow Bunting	1.92
House Sparrow	3.27	Evening Grosbeak	1.00

Listed in Appendix F, the other 47 species were uncommon or rare.

Eight species of waterbirds (waterfowl and gulls only) were recorded on the New Boston CBC, but none was common. Canada Goose was recorded at 0.95 birds/hr, the rest under 0.1 birds/hr. Open-country birds included Snow Bunting (1.92) and Horned Lark (NYS special concern, 0.16). Nonetheless, birds of these types are unlikely to occur at the Project site in winter, where waterbird habitat will be frozen and agricultural habitats are lacking.

Seven species of raptors were recorded at low frequencies. Only Rough-legged Hawk (0.14) and Red-tailed Hawk (0.13) exceeded 0.1 birds/hr.

Among woodland birds, a number of winter finches were recorded, but their frequencies were all fairly low: Common Redpoll (2.04, probably mostly at feeders), Evening Grosbeak (1.00, probably mostly at feeders), Pine Grosbeak (0.30), Pine Siskin (0.02), White-winged Crossbill (0.02), and Red Crossbill (0.01).

Regarding listed species (see Table 4.3-2), the only federally listed species recorded was the threatened Bald Eagle, was delisted by the USFWS in June 2007. Bald Eagle was not frequent on either count. Since the Project site does not front a major river or lake that would provide open water and foraging opportunities in winter, the Bald Eagle would not be expected.

With regard to state-listed species, one endangered and two threatened species were recorded in the two CBCs. The Watertown CBC recorded the endangered Short-eared Owl in two of ten years. This species forages in open country; therefore, it is unlikely to occur at the Project site.

The threatened Bald Eagle was discussed above. In the case of the threatened Northern Harrier, it also requires open country for foraging. Therefore, it is also unlikely to occur at the Project site.

Table 4.3-2. CBC Records for Listed Species, 1996-2005

Species[1]	CBC	Percent Years Recorded	Number Recorded per Year
Short-eared Owl (E)	Watertown	20%	2
Bald Eagle (T, US-Delisted)	New Boston	25%	1
	Watertown	40%	1-2
Northern Harrier (T)	New Boston	13%	1
	Watertown	80%	1-13
Common Loon (SC)	Watertown	20%	2
Sharp-shinned Hawk (SC)	New Boston	50%	1
	Watertown	90%	1-5
Cooper's Hawk (SC)	New Boston	38%	1-4
	Watertown	90%	1-4
Northern Goshawk (SC)	New Boston	75%	1-3
	Watertown	20%	1
Horned Lark (SC)	New Boston	50%	3-52
	Watertown	80%	1-179

[1] See Table 4.1-1.

Among the special-concern species, the Project site lacks open water to attract Common Loons. It also lacks agricultural habitats to attract Horned Larks. The three accipiters, however, are possible, but at low densities and frequencies. Northern Goshawk is perhaps the likeliest of the three, but it covers very large areas in search of snowshoe hares, grouse, and other large prey.

Among Green List species, only one was recorded – American Black Duck. At the Project site, its habitats will be frozen in winter.

In conclusion, CBC data indicate that the Project site will have very few birds in winter, when cold temperatures and deep snow severely limit foraging opportunities for birds. Of the listed species, Northern Goshawk is perhaps the likeliest to occur, but it requires such large foraging territories that its frequency will be extremely low.

5.0 Important Bird Areas, Reserves, and Sensitive Habitats in Project Vicinity

As part of the avian risk analysis, databases were checked to see if designated Important Bird Areas (IBAs) or federal, state, or private protected areas overlap with the Project site or are in close proximity. The presence or proximity of such areas could indicate the presence of sensitive habitats and increased avian risk.

5.1 Important Bird Areas (IBAs)

A program of BirdLife International and Audubon, the Important Bird Area (IBA) Program seeks to identify and protect essential habitats for one or more species of breeding or non-breeding birds. The sites vary in size, but usually they are discrete and distinguishable in character, habitat, or ornithological importance from surrounding areas. In general, an IBA should exist as an actual or potential protected area, with or without buffer zones, or should have the potential to be managed in some way for birds and general nature conservation. An IBA, whenever possible, should be large enough to supply all or most of the requirements of the target birds during the season for which it is important.

Audubon New York began the process of designating IBAs in 1996, seeking nominations from biologists, birdwatchers, and conservationists. To date, 136 IBAs have been designated in New York State (Burger and Liner 2005). One of them, the Tug Hill Area, appears to overlap the Project site. It was selected as a site for *Responsibility Species Assemblages*. This criterion identifies sites with the most important habitats for assemblages of bird species whose long-term conservation is the responsibility of New York State. Sites meeting this criterion usually consist of large, intact areas that support all or most of the responsibility species in any one habitat-species assemblage.

Based on Burger and Liner's description, this IBA covers 79,600 acres in Lewis County. It is a relatively unfragmented landscape (90% forested) that is ecologically distinct from the Adirondacks, owing to its alkaline shale and sandstone-based soils, which help buffer the area from acid rain. In contrast to this IBA, the Project site is somewhat fragmented/disturbed due to logging and road development.

According to Burger and Liner (2005), the Tug Hill Area supports a number of characteristic forest breeders, including the NYS special-concern American Bittern, Sharp-shinned Hawk, Northern Goshawk, and Bicknell's Thrush (also Green List) and the Green-List American Black Duck, American Woodcock, Wood Thrush, and Canada Warbler. The NYS threatened Bald Eagle has nested historically in the Tug Hill Area.

The Tug Hill Area is the focus of land conservation initiatives of The Nature Conservancy and the Tug Hill Tomorrow Land Trust. Threats to the area are described as unsustainable logging, residential and camp development, and ATV use in sensitive areas (Burger and Liner 2005).

In its list of the 500 most important bird areas in the U.S. (ABC 2003), the American Bird Conservancy (ABC) lists the Adirondack Park. This area contains eight of the New York IBAs. At its closest, the Park is located about 13.5 miles (21.6 km) east of the Project site. According

to ABC, its highlight is nesting habitat for Bicknell's Thrush and many warblers. The closest IBA within the Adirondack Park is Stillwater Reservoir, 30+ miles east of the Project site.

5.2 Federal, State, County, and Private Protected Areas

No federal protected areas are located near the Project site. As just noted, Adirondack Park is located approximately 13.5 miles away. Encompassing six million acres, Adirondack Park was created in 1892 by the State of New York in order to conserve the region's water and timber resources. Today, it is the largest publicly protected area in the contiguous U.S. – larger than Yellowstone, Everglades, Glacier, and Grand Canyon National Parks combined. Half of the park is still in private ownership. The other half is owned by New York State and is constitutionally protected to remain a "forever wild" forest preserve.

A perusal of the New York Atlas and Gazetteer (DeLorme 2003) shows that the Tug Hill Wildlife Management Area (WMA) abuts the Project site to the west. That WMA consists of 5,100 acres of upland hardwood forest, hardwood/coniferous wetlands (spruce/fir), and a 65-acre impoundment. The WMA is sits at the headwaters area of various watersheds. About 3,200 acres of the WMA are managed for wildlife in various forest successional stages via commercial forestry practices. In addition, some tracts held as state forest preserves are located within 3 miles (4.8 km) of the site mainly to the east and southeast. Some tracts are subject to "forever wild" provisions such that no logging will occur.

The Nature Conservancy (TNC) has been active in preserving 45,000 acres in the Tug Hill region, along the East Branch of Fish Creek. This area is immediately south of the Project site. It should be noted that the North Branch of Fish Creek originates in or near the Project site and flows into the East Branch. Most of the 45,000 acres are forested and will be logged in a sustainable manner under the supervision of DEC. For more information, visit http://www.nature.org/success/tughill.html.

Taken together, the Tug Hill Area IBA, nearby state WMA and forest preserves, and the nearby TNC project indicate that the extensive forests of the Tug Hill Plateau are important habitat for Northern Forest birds, including a number of species of conservation concern. The forests within the Project site are more fragmented from roads and are more heavily logged than either the TNC lands of the Tug Hill Area IBA and WMA.

6.0 Risk to Birds at the Proposed Roaring Brook Wind Power Project

6.1 Review of Risk to Birds at Wind Power Plants in the United States and Europe

Assessing risk to birds at a prospective wind-energy site may be accomplished by comparing a site's avian use with similar sites where avian risk has been determined through post-construction research. By comparing the types of species present or likely to be present, numbers of individuals, seasonality, and behavior of birds that nest, forage, migrate, or winter at a proposed wind-power site with existing facilities where risk has been determined, probabilistic assessments of risk can be made.

In this section, we review what is known about avian risk at existing wind-power facilities. Two general types of impacts have been documented: 1) disturbance and displacement of birds as a result of the construction and operation of wind turbines and related infrastructure, and 2) fatalities resulting from collisions with turbines, meteorology towers, and other infrastructure. These two types of impacts are detailed below.

For the present avian risk assessment, the literature on fatalities is reviewed, with a special emphasis on a study now being conducted at the Maple Ridge Wind Power Project in Lewis County, New York. That study is only a few miles to the northeast of the Roaring Brook site.

6.1.1 Disturbance and Displacement

Disturbance and habitat alteration resulting from the construction and operation of wind turbines and other wind-farm infrastructure has sometimes been found to make a site unsuitable or less suitable for nesting, foraging, resting, or other bird use. Avoidance and displacement has been documented in some species, but subsequent habituation to wind power project infrastructure has also been demonstrated.

The footprint of turbine pads, roads, and other infrastructure required for a wind farm is generally a small percentage of a project site, often estimated at two to four percent. Therefore, in general, overall land use is minimally changed by wind-power development, and habitat loss is generally small. This is particularly true in agricultural landscapes. But, in forested landscapes, the construction of a wind farm and its connection to the electricity grid may fragment habitat and affect wildlife populations (NRC 2007; see discussion below).

Despite the relatively small footprint of a wind farm, the true amount of wildlife habitat affected by a wind-power project may extend beyond the area of direct disturbance. This results from the presence and operation of the wind turbines, increased human activity to construct and maintain them, and fragmentation effects to remaining habitat. Various studies have examined the presence of tall wind turbines in landscapes to determine whether birds avoid or are displaced from an area as a result of these new features.

In the U.S., studies documenting disturbance, avoidance, and displacement have focused mainly on birds living in grassland and other open country habitats, including farm fields. At the Buffalo Ridge Wind Resource Area in southwestern Minnesota, Conservation Reserve Program

(CRP) grasslands without turbines and areas located 180 m (590 feet) from turbines were found to support higher densities (261.0-312.5 males/100 ha) of grassland birds that areas within 80 m (260 feet) of turbines (58.2-128.0 males/100 ha) (Leddy et al. 1999). This study also found that the activities of many grassland-nesting birds were inhibited within about 80 m (260 feet) to nearly 200 m (650 feet) of turbines. An impact-gradient study demonstrated that disturbance was greatest within the first 100 m (325 feet) of a turbine and decreased at greater distances. This means that, after the construction of turbines, some birds either do not nest or forage close to the turbines or do so at lower frequencies. Nonetheless, it should be noted that the Buffalo Ridge turbines are shorter than proposed ones, and closer together. These characteristics could have a considerable effect, not evident at larger widely spaced turbines.

At the Foote Creek Rim Wind Plant in Wyoming, the numbers of nesting Mountain Plovers (a grassland-nesting species) declined after erection of turbines. Plover productivity also declined (Johnson et al. 2000), although successful nesting of Mountain Plovers was noted within 200 m (650 feet) of operating turbines. Thus, the area impacted extended beyond the actual footprint of the project.

Curiously, at Tarifa, Spain, some songbirds nested at higher densities and with higher productivity on a ridge with wind turbines than on two other ridges without wind turbines (de Lucas et al. 2004). A sheltering effect from passerine predators (e.g., Booted Eagles) by wind turbines has been suggested, but the study did not analyze habitat differences between sites to exclude that possibility.

At the Erie Shores Wind Farm in Ontario, Canada, a 66-turbine (100-MW) project along Lake Erie, Killdeer nested at distances of 4 to 28 m (9 nests) from the bases of towers, Horned Larks at 15, 21, 37 and 40 m, Vesper Sparrow at 30 m, and Savannah Sparrow at 16 and 20 m. They were more effected by farming practices, including hay mowing and tilling, than by the presence of the operating turbines (Ross D. James, personal communication).

The Altamont Pass Wind Resource Area of California (APWRA) hosts very large numbers of raptors and grassland-nesting songbirds, which regularly perch on the lattice towers and guy wires of the site's older turbines. In a study in the APWRA, Red-tailed Hawks trained for falconry in Idaho were exposed to turbines in order to study their flight behavior near those structures. Upon first seeing the turbines at 100 feet (30 m), the birds would not fly. Within weeks, however, they appeared to habituate to the turbines in a manner comparable to resident Red-tailed Hawks (R. Curry, personal communication). Unlike most other wind power sites in the United States, turbines have been present in the APWRA for about 20 years, and resident birds have had ample time to habituate to them.

At Erie Shores Wind Farm (Ross D. James, personal communication), construction activity in 2006 displaced a pair of Bald Eagles nesting within about 400 m (1,310 feet) of a proposed turbine location, but the pair established a new nest about 900 m (2,950 feet) away and successfully raised two young. This pair returned to the new nest in 2007. Local conservationists believe that, if construction had taken place outside of the breeding season, the eagle pair would not have abandoned the original nest (Peter Carson and Mary Gartshore, personal communication). These adults and juveniles were seen perched within 200 m (660 feet)

of active turbines, and on a few occasions they were observed flying closer than 100 m (330 feet) of turbines that were not rotating. When turbines were rotating, the immature birds were observed twice flying within 200-400 m (660-1,310 feet). An adult showed no hesitation in circling very close to an operating wind turbine before it quickly turned away.

Also at Erie Shores Wind Farm (Ross D. James, personal communication), a pair of Red-tailed Hawks nested within 135 m (215 feet) of a turbine under construction. The turbine was in operation about a month before the young had fledged, during which time the adults made hundreds of trips to the nest. They were observed on numerous occasions negotiating the airspace around the spinning rotors, on one occasion as close as 5 m (16 feet). Another pair nested in the vicinity of three turbines and were often seen perching and hunting within 100 m (330 feet) of them. In 2007, the Red-tailed Hawk returned to nest, but it moved to 275 m from the nearest turbine. This location was in the middle of a quadrangle of turbines instead of on the edge of the wind farm. Cooper's Hawk nests were found at 110 and 175 m away from the closest turbines.

In Europe, studies have shown that some waterfowl, shorebirds, and grassland songbird species avoid areas near turbines. For example, shorebirds (mostly migrants) were displaced by 250-500 m (800-1,650 feet) from turbines (Winkelman 1990). In Denmark, some migrant shorebirds were displaced by up to 800 m (2,600 feet) by the presence of turbines (Pederson and Poulsen 1991). Other studies have shown that some shorebirds and other birds can habituate to turbines to some degree (Ihde and Vauk-Henzelt 1999, Winkelman 1990). Studies have not yet been conducted to examine behavioral changes or habituation of birds to wind turbines over periods as long as five to ten years after construction. Therefore, it is not known if these species remain permanently displaced.

Other studies conducted in Denmark, have demonstrated species-specific differences in avian avoidance patterns near wind turbines (Larsen and Madsen 2000, Percival 1999, Kruckenberg and Jaene 1999). In general, Pink-footed Geese (Larsen and Madsen 2000) would not forage within 50 m (160 feet) of wind turbine rows and did not forage within 150 m (500 feet) of a cluster of wind turbines. Fewer of these geese foraged within 100 m (325 feet) of wind turbines than foraged farther from the turbines. Barnacle Geese, however, foraged within about 25 m (80 feet) of turbines, showing they are less sensitive than Pink-footed Geese (Percival 1999). Nonetheless, White-fronted Geese did not forage within about 400 to 600 m (1,300 to 1,950 feet) of wind turbines (Kruckenberg and Jaene 1999). Therefore, different species react differently to wind turbines. Nonetheless, research has not been conducted to determine if particular species will habituate to wind turbines and, if so, how long that process might take.

In contrast to some European studies, two years of post-construction studies at the Top of Iowa Wind Plant (Koford et al. 2005, Jain 2005) revealed that Canada Geese were not displaced significantly by the construction of 89 turbines. That study, designed by Iowa State University and the Iowa Department of Natural Resources, was the first disturbance/displacement study of waterfowl in the United States. Anecdotal information from the Fenner Wind Power facility in New York State (Paul Kerlinger) also suggests that Canada Geese forage in close proximity to large wind turbines.

At the Erie Shores Wind Farm (Ross D. James, personal communication), Canada Geese appeared not to be inhibited from flying through the wind farm or from using fields and ponds within 200 m of operating turbines. Of 650 Tundra Swans seen on fields in spring 2006, before the wind farm was in operation, roughly 45% were 200-400 m from a turbine, with the remainder 400-800 m away. When these birds took off, they could have flown in a direction where there were no turbines; instead, they flew through the wind farm, with several groups making flight changes that brought them closer to turbines. During fall migration, when turbines were in operation, most swans were observed flying high over turbines or out over Lake Erie. Nevertheless, some flocks flew within 200 m (660 feet) of the turbines, including a small group of birds within 100 m (330 feet) at rotor height.

Regarding forest-breeding species, a post-construction study of 11 turbines located on a ridgeline in Searsburg, Vermont, appears to be the only applicable study on disturbance and displacement impacts (Kerlinger 2000a, 2002b). Point count surveys for breeding birds done before and after the turbines were erected showed that some forest-nesting birds – such as Blackpoll Warbler, Yellow-rumped Warbler, White-throated Sparrow, and Dark-eyed Junco – appeared to habituate to the turbines within a year of construction. On the other hand, Swainson's Thrush, and perhaps some other species, appeared to be displaced by the turbines. This study could not document whether or not the former species nested close to the turbines, but it certainly demonstrated that they foraged and sang within forest edge about 100 feet (30 m) from the turbine bases. A visit to the site during the 2003 nesting season revealed that Swainson's Thrushes were singing (and likely nesting) within the forest adjacent to turbines, and many other species were present close to the turbines. It is not known if overall numbers of nesting birds were the same as prior to construction, but letting the forest grow up to turbines and roadways may have reduced the fragmentation impacts at that site. It is also possible that habituation had occurred.

At Erie Shores Wind Farm (Ross D. James, personal communication; John Guarnaccia, personal observation), some turbines are situated at the edge of woodlots, but resident woodland and woodland-edge birds appeared to have habituated readily to their presence, including forest-interior species, such as Wood Thrush.

In a recent review of the literature on the ecological effects of wind-energy development (NRC 2007), the following conclusions and recommendations were made regarding effects on forest ecosystems (pg. 91):

1. Forest clearing resulting from road construction, transmission lines leading to the grid, and turbine placements represents perhaps the most significant potential change through habitat loss and fragmentation for forest-dependent species.
2. Changes in forest structure and the creation of openings may alter microclimate and increase the amount of forest edge.
3. Plants and animals throughout the ecosystem respond differently to these changes, and particular attention should be paid to species of concern that are known to have narrow habitat requirements and whose niches are disproportionately altered.

Nevertheless, the effects of wind-energy projects on ecosystem structure and bird habitats depend on the pre-construction conditions. For example, the influences of a project at a

previously logged site will be different than those at a previously undisturbed site (NRC 2007). What the NRC report did not do was examine alternative uses of a particular wind power project site such that landowners can develop their properties, but do so in ways that provide for long-term sustainable forestry or other habitat practices. A model for such alternatives is that used by the Nature Conservancy for sustainable forestry in the Tug Hill area. In this fashion, the ultimate, long-term disposition of private lands can be examined from a conservation and economic perspective.

Regarding migratory birds, there is a study of three ridges (one with turbines, two without) at Tarifa, Spain, where over 72,000 migrating birds (principally Black Kites, White Storks, House Martins, and Swallows) were recorded during nearly 1,000 hours of observation from fixed observation points (Janss 2000, de Lucas et al. 2004). Observations of flight behavior indicated that birds were aware of, and possibly avoided, the turbines. Changes in flight direction were recorded more often over the wind farm than over the other two areas. Migrants also tended to fly higher over the wind farm. These findings could indicate avoidance by migrating birds, but no comparable data were obtained prior to operation of the turbines. In contrast, resident Griffon Vultures were not observed to fly higher over the wind farm. Possibly they were more accustomed to the turbines.

Observations of autumn hawk migration in Vermont showed that the numbers of hawks that flew close to a hill with newly constructed turbines was less than in the year prior to turbine construction and operation (Kerlinger 2000b). These migrants may have been avoiding the novel structures.

At Erie Shores Wind Farm (Ross D. James, personal communication), where there is a significant fall hawk migration, including Osprey, Bald Eagle, Northern Harrier, Sharp-shinned Hawk, Cooper's Hawk, Northern Goshawk, Red-tailed Hawk, Golden Eagle, American Kestrel, Merlin, and Peregrine Falcon. The few Red-shouldered and Broad-winged Hawks recorded were very high above the wind farm. Curiously, when Sharp-shinned Hawks changed direction to follow a fencerow with trees, it brought them closer (within 50 m [165 feet]) to a particular turbine. Migrating raptors appeared to negotiate the turbines easily.

Drewitt and Langston (2006) speculate that some wind farms may create barriers for some species that alter migratory or local flight paths, increase energy expenditure, and disrupt linkages between feeding, roosting, molting, and breeding areas to such an extent that they may, under certain circumstances, lead indirectly to population-level impacts. This phenomenon is more of a concern in offshore wind projects, where significant changes in flight direction by waterbirds have, in some cases, been noted. Drewitt and Langston's review of the literature suggests that none of the barrier effects identified so far have had significant population-level impacts. They have also not noted whether birds habituate to turbines and are impacted less over a period of years following construction of new wind power projects.

In summary, limited research on bird disturbance and displacement suggests that grassland and other open-country birds avoid turbines, or are displaced by them, at least to a greater degree than forest species. It is also evident that there are species-specific differences, with some species being displaced farther than others, while others habituate to turbines. Much more

research is required, however, to fine tune understanding of displacement and habituation. Nonetheless, results from the nearby Erie Shores Wind Farm appear to indicate that the same species of waterfowl, raptors, and landbirds occurring in the study area have habituated to the project relatively quickly, with ample evidence of nesting, feeding, and flying near the turbines.

6.1.2 Collision Fatalities

Collision mortality is well documented at wind-power sites in the United States. An estimated 20,000 to 37,000 birds were killed at about 17,500 wind turbines of 6,374 MW of total capacity in the United States in 2003 (Erickson et al. 2005), yielding on average mortalities of 2.11 birds per turbine per year and 3.04 birds per MW per year. As will be discussed below, fatalities were spread among dozens of species, revealing taxonomic differences in collision susceptibility. Studies from the Eastern United States reveal slightly higher fatality levels than farther west.

Erickson et al. (2005) have attempted to put this mortality in context. Based on various studies reviewed in their paper, they estimated that annual bird mortality from human-caused sources may easily approach one billion birds in the U.S. alone. Of this estimate, collisions from wind turbines amounted to <0.01%. The major mortality sources were buildings (550 million, 58.2%; Klem 1990), power lines (130 million, 13.7%; Koops 1987), cats (100 million, 10.6%; Coleman and Temple 1996), automobiles (80 million, 8.5%; Hodson and Snow 1965, Banks 1979), pesticides (67 million, 7.1%), and communications towers (4.5 million, 0.5%; M. Manville, personal communication). While the uncertainties in the estimates are large, the numbers are so large that they cannot be obscured even by the uncertainties (NRC 2007).

Based on best available estimates, Erickson et al. (2005) figure that human-caused mortality may take approximately 5% to 10% of the U.S. landbird population each year. The biological significance of this take at a population, regional, or even local level is as yet uncertain, but the best wildlife management practices routinely allow takes at or above these levels for waterfowl populations, including species of conservation concern.

With respect to collision impacts from wind turbines, the standard method for studying them requires systematic searches below turbines to record the bird and bat carcasses found. This number is then adjusted to take into account searcher efficiency (searchers do not find all the carcasses) and carcass removal (scavengers may remove some carcasses before searchers look for them). According to best practices (Anderson et al. 1999, NRC 2007), searcher efficiency and carcass removal tests should be regularly conducted to account for different habitats, seasonal changes in ground cover, and fluctuations in scavenger populations.

Criticism is sometimes made that mortality studies at wind-power projects grossly underestimate mortality because searcher efficiency and carcass removal are not adequately tested and taken into account. The best answer to this criticism is the recent survey of environmental impacts of wind-energy development (NRC 2007). This survey found that data allowing accurate estimates of bird fatalities at wind-energy projects in the United States are limited, but fourteen studies have been conducted using a survey protocol for an annual period and incorporating searcher-efficiency and scavenging biases into estimates. Although the protocols used in these studies varied, all used similar protocols (Anderson et al. 1999).

Table 6.1.2-1. Mortality Reported at U.S. Wind-Energy Projects (from NRC 2007)

Wind Project	# Turbines	Turbine MW	Project MW	All Bird Mortality Turbine per year	All Bird Mortality MW per year	Reference
Pacific Northwest						
Stateline, OR/WA[1]	454	0.66	300	1.93	2.92	Erickson et al. 2004
Vansycle, OR[1]	38	0.66	25	0.63	0.95	Erickson et al. 2004
Combine Hills, OR[1]	41	1.00	41	2.56	2.56	Young et al. 2005
Klondike, OR[1]	16	1.50	24	1.42	0.95	Johnson et al. 2003
Nine Canyon, WA[1]	37	1.30	62	3.59	2.76	Erickson et al. 2003b
Rocky Mountain						
Foote Creek Rim, WY, Phase I[2]	72	0.60	43	1.50	2.50	Young et al. 2001
Foote Creek Rim, WY, Phase II[2]	33	0.75	25	1.49	1.99	Young et al. 2003
Upper Midwest						
Wisconsin[3]	31	0.66	20	1.30	1.97	Howe et al. 2002
Buffalo Ridge, MN, Phase I[3]	73	0.30	33	0.98	3.27	Johnson et al. 2002
Buffalo Ridge, MN, Phase I[3]	143	0.75	107	2.27	3.03	Johnson et al. 2002
Buffalo Ridge, MN, Phase II[3]	139	0.75	104	4.45	5.93	Johnson et al. 2002
Top of Iowa[3]	89	0.90	80	1.29	1.44	Koford et al. 2004
East						
Buffalo Mountain, TN[4]	3	0.66	2	7.70	11.67	Nicholson 2003
Mountaineer, WV[4]	44	1.50	66	4.04	2.69	Kerns and Kerlinger 2004

[1] Agricultural/grassland/Conservation Reserve Program (CRP) lands

[2] Shortgrass prairie

[3] Agricultural

[4] Forest

As can be seen in Table 6.1.2-1, there were some differences in the type and number of turbines at these projects, as well as in the geographic location and habitats where the projects were constructed. Mortality estimates were similar among projects, however, averaging 2.51 birds per turbine per year and 3.19 birds per MW per year, despite the differences in methodology, geography, and habitat. This suggests that the results of these studies were quantitatively robust. The values at the Tennessee site are high when compared with the other sites, but even that level of mortality is far from indicating significant biological impacts at the population, regional, or local level (see human-caused mortality and waterfowl harvest discussions above).

Except when noted otherwise, in the following survey of European and U.S. wind-energy projects, the numbers given are the numbers of carcasses found. As explained above, the number of fatalities would be higher when searcher-efficiency and the carcass-removal rates were factored in.

In Europe, reported avian fatalities have generally been small at wind power plants. But, there are a few localities where greater numbers of fatalities have been found. At a wind power site with 18 turbines in the coastal Netherlands, dozens of songbirds and a variety of shorebirds were reported to have collided with wind turbines during a migration season (Winkelman 1995). At another wind plant in the Netherlands, where turbines were erected in a saltwater lake, about 65 waterfowl fatalities were noted in one winter (Winkelman 1995). These sites are adjacent to the North Sea, where migratory and wintering birds are densely concentrated. That several species were killed reduced the potential for significant population impacts on any one species. There are also higher fatality rates reported from Belgium, with respect to terns and gulls, at turbines located on harbors and adjacent to open water (Everaert 2002), and from Navarre in northern Spain (Lekuona 2001), where large numbers of resident Griffon Vultures have apparently been killed.

Fatalities of migrants have been relatively rare at most other European sites. Of particular interest is the relative lack of fatalities, given the migration traffic, at Tarifa, Spain, where several hundred thousand soaring birds, including more than 100,000 raptors, and millions of other birds, converge on the Straits of Gibraltar to cross between Europe and Africa (Marti Montes and Barrios Jaque 1995, Janss 2000, Barrios and Rodriguez 2004, and de Lucas et al. 2004). Not only have mortality studies recorded few migrants, but studies of birds exhibiting behaviors that put them at risk of collision (i.e., flying within 5 m [16 feet] of wind turbines) show that most migratory species do not exhibit these behaviors (Barrios and Rodriguez 2004). The birds that do exhibit these behaviors at Tarifa are resident raptors, particularly Griffon Vulture and Kestrel. In the case of the Griffon Vulture, mortality was concentrated in the fall and winter, when absence of strong thermals forced resident birds to use slopes for lift. Most mortality occurred during light winds, when birds probably could not maneuver as well. In the case of the Kestrel, most deaths occurred during the annual peak of abundance in summer and appeared to be related to wind turbine location in preferred hunting habitat (Barrios and Rodriguez 2004). Similar Griffon Vulture mortality did not occur at all Tarifa wind farms (de Lucas et al. 2004).

Elsewhere in Spain, significant Griffon Vulture mortality has been recorded at wind-energy projects in the Pyrenees Mountains of Navarre. The causes for this relatively high mortality

appear to be closely spaced turbine placements on habitual soaring ridges used by a resident population of habituated birds (Lekuona 2001). Mortality was found to be higher under low wind conditions, when birds were likely less maneuverable.

The only wind power site in the United States where risk to birds has been suggested to be significant is the Altamont Pass Wind Resource Area (APWRA), where raptor fatalities have been reported for over 15 years. Golden Eagles, Red-tailed Hawks, American Kestrels, and other species collide with turbines in varying numbers. These findings suggest that raptors are the most collision-susceptible group of birds (Anderson et al. 2000). Nevertheless, such fatalities have not impacted regional populations. A long-term study of the Altamont Golden Eagle population by Hunt (2002) concluded that, despite the high fatality rate, the population remains stable. Large numbers of gulls, ravens, vultures, grassland songbirds, and other species fly amongst the APWRA turbines and rarely collide with the turbines. The raptor fatalities in the APWRA are an anomaly, because they have not been demonstrated elsewhere. Other studies conducted at U.S. wind power facilities outside of the APWRA have not revealed large numbers of raptor fatalities.

Several factors are believed to contribute to raptor risk in the APWRA, and some can be generalized to other species. These factors act alone or together to produce the collision mortality documented in the APWRA (Howell and DiDonato 1991, Orloff and Flannery 1992, 1996). They are:

- Large numbers of turbines (presently about 5,400, down from about 7,000 several years ago) concentrated in a small area and providing many obstacles to flight
- Closely spaced turbines (less that 10 m [30 feet] rotor-to-rotor distance) that may not permit birds to fly safely between them
- Extraordinary numbers of foraging raptors throughout the year, the result of a superabundant population of California ground squirrels
- Steep topography with turbines placed in valleys and along valley and canyon edges, where collision risk is greater
- Turbine rotors that sweep down to less than 10 m (30 feet) from the ground, affecting airspace where raptors forage extensively
- Turbines mounted on lattice-type towers that encourage perching and provide shade and cover from sun and rain
- Small turbine rotors that revolve at high rates (40-72 rpm) making the rotor tips difficult to see

West of the Rocky Mountains, avian mortality resulting from collisions with wind turbines has been studied at sites in California, Oregon and Washington State. With the exception of the APWRA, reported fatality numbers have been small. At San Gorgonio Pass and in the Tehachapi Mountains, relatively few birds were killed in two years of searches, including very low representation of raptors (Anderson 2000). One Golden Eagle has been found in the San Gorgonio Wind Resource Area in more than two years of study. At a new wind power site in Oregon, at which there are 38 turbines in farmland, a one-year study documented no raptor fatalities, eight songbird fatalities, and four gamebird fatalities (three of which were alien species). The estimated number of actual fatalities was greater (N = 24 fatalities; 0.63 fatalities

per turbine per year), when searcher efficiency and carcass removal (scavenging) estimates were factored in.

The State Line project on the Washington/Oregon border is one of the world's largest wind power facilities. As presented in Table 6.1.2-1, the fatality rate per turbine per year has been found to be slightly less than two birds per turbine per year (Erickson et al. 2002, 2003, 2004). That project now has 454 turbines. Among the fatalities were a variety of species, with Horned Larks (locally nesting birds) accounting for 46% of all birds found. Six raptors from three species were killed, and about 24% of fatalities were night migrating songbirds. The rates of avian fatalities at smaller wind power sites in Oregon (Klondike) and Washington (Nine Canyon) averaged slightly lower and higher, respectively. Birds killed were divided among night migrants, resident species, very few waterfowl, and small numbers of raptors. The rate of night migrants killed in the far west has been roughly one bird per turbine per year or less, which includes carcass removal and searcher efficiency correction factors

Most of the projects in the western United States discussed above were situated in tilled agricultural fields or pasture/prairie-like habitats. It should be noted that many of the turbines involved in California studies were less than 200 feet in height and did not have FAA lights. All turbines in Oregon and Washington were taller than 275 feet and a subset (perhaps one in three to one in four) of them had FAA lights (the presence or absence of lights is significant, because, as discussed below, lighting has been implicated in large-scale fatality events at communication towers). There has been no suggestion of population impacts at any of these facilities, nor have fatalities involved endangered or threatened species.

In the Rocky Mountain region, after five years of systematic searches at 29 modern turbines (expanded to 45 in the third year) in a short-mixed grass prairie/pasture land in northern Colorado, small numbers of fatalities were documented (Kerlinger, Curry and Ryder, unpublished). The fatalities were mostly Horned Larks, with fewer McCown's Longspur, White-throated Swifts, one teal, one American Kestrel, one Lark Bunting, and some other songbirds. The prevalence of Horned Larks on the fatality lists is likely a result of their aerial courtship flight during which they display and sing at the height of the rotors.

In Wyoming, at the Foote Creek Rim project (presented in Table 6.1.2-1), also in a short-mixed grass prairie habitat, 90 fatalities were recorded, 75 of which were at wind turbines and 15 of which were at meteorology towers with guy wires (Young et al. 2003). Thus about 20% of the fatalities resulted from collisions with guy wires at the meteorology towers and likely would have been avoided by using free-standing towers. This means the fatality rate per structure is about two to four times greater at the guyed meteorology tower than at the turbines. (Virtually no birds are known to be killed at free-standing meteorology towers.) Few raptors were found dead at the Foote Creek Rim project (three American Kestrels and one Northern Harrier) and 48% of the fatalities were night migrating birds. Of the migrants, no species accounted for more than five to seven individuals (including Chipping and Vesper Sparrows).

A number of projects have been studied in the upper Midwest. In Kansas, Young (2000) noted no fatalities at the two turbines in the Jeffrey Energy Center in Pottawatomie County. In Minnesota, at the Buffalo Ridge wind power facility (approximately 400 turbines; see Table

6.1.2-1) near Lake Benton, relatively small numbers of fatalities have been reported (Johnson et al. 2002) during four years of searching at subsets of the turbines. The fatality rates per turbine ranged between about one bird per turbine per year to about four birds per turbine per year. The species composition included a variety of birds, including one raptor (Red-tailed Hawk), very few waterbirds, and a number of night-migrating songbirds (about 70% of the 53 documented fatalities). Only about five ducks and coots were found during the study, despite their regular presence around the wind power site and the fact that the wind farm is within a major migration area for waterfowl (Bellrose 1970).

In Iowa, a study at a small wind plant reported no fatalities (Demastes and Trainor 2000). A two year study recently completed by Iowa State University and the Iowa Department of Natural Resources at the Top of Iowa Wind Power Project site revealed no fatalities to Canada Geese or other waterfowl (Koford et al. 2005). This study is important because the 89 turbines were located within one to two miles of three waterfowl management areas. Despite intense use of the turbine fields by waterfowl (>1.5 million duck and goose-use-days per year), none were killed. In addition, no shorebirds were killed, but one raptor (perhaps two) was recorded in the mortality study. As presented in Table 6.1.2-1, fewer than 1.5 birds per turbine per year were found to be killed at this site.

In Wisconsin, two years of carcass searches under 31 turbines situated in farm fields in the Kewaunee County peninsula found about two dozen songbird fatalities, mostly migrants. Perhaps six of the documented fatalities were night migrants. One Mallard and one Herring Gull were the only two waterbirds found dead at this site (Howe et al. 2002). The authors estimated that each turbine killed between one and two birds per year, when searcher efficiency and carcass removal rates were factored into the estimates. A study of two modern wind turbines at Shirley revealed one night migrating songbird fatality during a year-long study (Howe and Atwater 1999).

In the northeastern United States, where wind farms have been developed only since the late 1990s and early 2000s, there are fewer in depth studies of collision fatalities at turbines than in the west. But, there is information from seven wind power facilities in the eastern United States and one across Lake Erie in Canada that are relevant to the study area, involving many of the same species and migration behaviors, especially among night migrants.

At the Meyersdale Wind Energy Center, located in southwest-central Pennsylvania, a total of 13 avian carcasses, representing six or more species, were found below 20 turbines during searches from July 30 to September 13, 2004. Two studies have been conducted at the Mountaineer Wind Energy Center on Backbone Mountain in West Virginia. This site has 44 turbines, twelve of which were lit with FAA-certified red strobes. In 2003, Kerns and Kerlinger (2004; see Table 6.1.2-1) found a mortality rate of about four birds per turbine per year, including between two and three night migrants per turbine per year. One duck and three raptors (two Turkey Vultures and one Red-tailed Hawk) were also found. In 2004, Arnett et al. (2005) found a total of 15 avian carcasses during a six-week period, with 13 of those individuals representing night-migrating songbirds or songbird-like species. The other two birds were a Turkey Vulture and a Sharp-shinned Hawk. Both these sites experience a fairly heavy fall raptor migration, but raptor mortalities have been minimal, limited apparently to mostly resident birds.

At a facility with eight modern turbines (four with red-flashing FAA lights approximately 280 feet [85 m] tall) located in farmland at Garrett, Somerset County, Pennsylvania, seventeen rounds of fatality searches conducted from June 2000 through May 2001 revealed no avian fatalities (Kerlinger 2001).

In central New York State, the Madison and Fenner Wind Power Projects are located in cropland. The Madison site has seven modern turbines that reach a maximum height of about 120 m (390 feet) tall and are all lit with FAA red strobes (type L-864). Four collision fatalities have been recorded at the turbines, plus one at a guyed meteorological tower (Kerlinger 2002a). During the spring and fall migrations, each turbine was searched five and six times, respectively. If carcass removal and searcher efficiency rates at the Madison site were similar to those at other projects, the numbers of fatalities would likely be on the order of two to four-plus birds per turbine per year. Of these fatalities, most would be night-migrating songbirds and similar species. The Fenner project has 20 turbines. In mid 2004, the plant manager reported no fatality events for raptors or other large birds (Paul Kerlinger, pers. comm.). Nevertheless, biologists from the New York State Department of Environmental Conservation (NYSDEC) made a site visit during 2004 and found small numbers of dead bats.

In upstate New York, on the Tug Hill Plateau of Lewis County near Harrisburg, several months of daily searches during spring and autumn migration beneath two unlit wind turbines (168 feet [51 m] tall) located in open fields revealed no carcasses (Cooper et al. 1995). At Searsburg in southeastern Vermont, searches done in June through December 1997 (nesting through fall migration) revealed no fatalities at eleven new, unlit turbines (192 feet [58 m] tall) situated on a forested hilltop (Kerlinger 2000a and 2002b).

The greatest fatality rate found for birds at turbines in the United States was about close to about eight birds per turbine per year under three turbines on a forested mountaintop in eastern Tennessee. The two-year study of the 290-foot (88-m) turbines equipped with white strobes revealed several dozen fatalities, mostly night migrating songbirds (Nicholson 2003). Lighting may have played an important role in these fatalities, but it is also possible that the larger rate of fatalities is the result of the more southerly latitude of this project, where migrants are more concentrated (see discussion in Section 4.2.1). A followup study at that site at a greater number of turbines that were much taller, revealed a fatality rate of about 2-3 birds per turbine per year, more in line with the fatality rates found at other eastern and Midwestern wind power facilities.

At the Erie Shores Wind Farm in Ontario, Canada, (Ross D. James, personal communication), a mortality study is in progress, but 2006 data, including searcher-efficiency and carcass-removal trials, permit a preliminary mortality estimate. In 2006, searches found 32 carcasses where mortality was apparently or probably the result of collision. Of these birds, 78% were small passerines with most nocturnal migrants. All were common species, including Warbling Vireo, Red-eyed Vireo, Bank Swallow, Golden-crowned Kinglet, Ruby-crowned Kinglet, Hermit Thrush, Cedar Waxwing, Magnolia Warbler, Yellow-rumped Warbler, Black-and-white Warbler, and Indigo Bunting. Raptors included one Turkey Vulture and one Sharp-shinned Hawk. One Virginia Rail was found. Of the hundreds of diurnal raptors and thousands of

diurnal passerine migrants observed through the site in fall migration, only one diurnal migrant mortality was recorded – the Sharp-shinned Hawk.

The 2006 mortality was estimated at 4.38 birds/turbine per year. Some patterns of mortality were apparent. Nearly 90% of nocturnal-migrant mortality was recorded at turbines with aviation-warning lights, which in the case of the Erie Shores project are steady-burning red (like L-810 FAA obstruction lights). Environment Canada has requested that these lights be changed to the type of flashing red lights we will recommend in this report.

The wind power project site that is most relevant for comparing fatalities to the Roaring Brook site is the Maple Ridge Wind Power Project, which is located only a few miles to the northeast of the Roaring Brook site. Although the habitat is somewhat different, the Maple Ridge site will likely experience the same migration as the Roaring Brook site. In the first year of study at Roaring Brook (June through November 2006) the fatality rates ranged between about 2 and 9 birds per turbine for the study period. The weighted average for that period was about 4 bird fatalities per turbine. Most impacts were to night migrating birds, mostly songbirds. There were very few raptors, waterfowl, or shorebirds killed, and no species listed as endangered or threatened were killed. During the second year of the study, the results appear to be very similar to the first year fatality study and it appears that annual fatality rates are somewhat greater than other wind power facilities in the eastern United States.

In summary, studies at these and other sites have shown fatalities to be relatively infrequent events at wind farms. No federally listed endangered or threatened species have been recorded, and only occasional raptor, waterfowl, or shorebird fatalities have been documented. In general, the documented level of fatalities has not been large in comparison with the source populations of these species, nor have the fatalities been suggestive of biologically significant impacts to these species.

6.2 Avian Risk Assessment for the Roaring Brook Wind Power Project

6.2.1 Disturbance and Displacement Risk at the Roaring Brook Project

As detailed in Section 6.1.1, some types of birds are disturbed and displaced more by wind turbine construction and operation than others. Disturbance and displacement effects are well documented in grassland and prairie birds and in some (but not all) waterfowl. Some European studies have demonstrated displacement of shorebirds. Forest birds, on the other hand, do not generally appear to be disturbed or displaced in a significant way by wind turbine operation, but forest fragmentation as a result of wind farm construction may impact forest-interior birds that are sensitive to edge effects. Resident raptors may be displaced by construction activities during nesting season, but they appear to habituate to the turbines after the construction phase. In Spain, migrating raptors have been shown to avoid operating wind turbines more than resident raptors, but this behavior likely greatly reduces collision mortality, a good thing at a migration bottleneck.

Turning specifically to the Project site, grassland birds will not be displaced or disturbed by the Project, because the site lacks habitat for them. Because waterfowl, shorebirds, and herons do not concentrate at the Project site, displacement effects, if they were to occur, are unlikely to have a significant effect at a regional population level.

With respect to raptors, some disturbance impacts may occur if wind turbines are constructed near nesting sites, but recent examples from the Erie Shores Wind Farm, cited above, show remarkable adaptability on the part of Red-tailed Hawks and even Bald Eagles (NYS threatened). Raptor migration will occur at heights far above the sweep of wind-turbine rotors. Therefore, it is unlikely that migrating hawks will be disturbed or displaced.

Regarding forest birds, after the construction phase, forest-edge species may be expected to habituate readily to the Project. For some early successional species, Project construction may increase available habitat. For forest-interior species, particularly Wood Thrush (Green List), edge effect resulting from habitat removal for access roads and turbine construction areas, may make a significant portion of the Project site less suitable. But, the areas where turbines are to be constructed have already been heavily logged and are crisscrossed by logging roads. If the site were undisturbed forest, displacement effects could be significant for certain species, but since the site is already heavily disturbed, these effects should be much less than for an undisturbed site.

NYS-listed species that could possibly nest at the Project site include the special-concern American Bittern, Sharp-shinned Hawk, Cooper's Hawk, Northern Goshawk, and Red-shouldered Hawk. If any do nest, it would be at low densities. The Project would be constructed away from the wetland habitat required by the bittern. The raptors would likely habituate to the project.

Finally, some birds may be displaced temporarily during the construction phase, as heavy equipment passes through the area and as new roads are constructed. This impact is likely to be temporary and decrease markedly after construction.

6.2.2 Collision Risk at the Roaring Brook Wind Power Project

Given that collision risk varies with bird type, we will treat the various bird groups separately. These groups are nocturnal migrant songbirds, raptors, waterbirds, and listed species. It should be noted that one species not in these categories – American Woodcock (Green List) – performs aerial flight displays that are sometimes at rotor height. Various data sources show that the woodcock occurs at the Project region.

6.2.2.1 Nocturnal Migrant Songbirds

Table 6.1.2-1 lists the results of mortality studies where searcher-efficiency and carcass-removal rates were determined and used to calculate overall fatalities (NRC 2007). At these fourteen projects, the percentage of night-migrating songbirds killed increased from west to east, presumably in response to the density of migration traffic. At the Stateline project in the West, the percentage of night migrants killed was 24%; at Foote Creek Rim in the Rocky Mountains, 48%; at Buffalo Ridge in the Upper Midwest, 70%; and at Mountaineer, in the East, 70.8%. At the Maple Ridge site in northern New York, the percentage of night migrants was about 80%.

Most reports of night-migrant fatalities are of single birds, unlike the large-scale events documented over the past sixty years at communication towers greater than 500-600 feet (152-183 m) in height (Avery et al. 1980). That nocturnal migrants collide at a lower rate with wind turbines than with tall communication towers is related to the much greater height of the communication towers that were involved, as well as to the presence of guy wires (Kerlinger 2000c) and steady-burning FAA red lights (L-810 obstruction lights) on communication towers.

The communication towers that are responsible for the largest numbers of avian fatalities, including virtually all of those where large numbers have been killed in a single night, are almost entirely taller than 500-600 feet (152-183 m; from literature and recent unpublished studies). Such towers are slightly to much taller than the turbines proposed for the study area (146.5 m). The most recent literature surveys conducted by the FWS and the U.S. Department of Energy (Trapp 1998, Kerlinger 2000b, Kerlinger 2000c) reveal virtually no large scale mortality events at communication towers less than 500-600 feet in height. It should be noted that the few communication towers less than 500 feet in height associated with reports of large-scale fatality events have been immediately adjacent to bright lights. At these sites, steady burning sodium vapor lights or other bright lights have been shown to be present (Kerlinger 2004a, b). Very attractive to birds, sodium vapor lights are very different from the lights stipulated by the FAA for wind turbines.

The fact that there are no guy wires on modern wind turbines is of critical importance, because it is the guy wires of tall communication towers that account for almost all of the collisions. The literature does not reveal many fatalities at free-standing communication towers that are as tall as 475 feet with very few exceptions (Gehring and Kerlinger 2007a, Central Michigan University, unpublished study of communication towers in Michigan). Recently, studies at 400-475 foot tall unguyed communication towers revealed between about zero and two birds killed per tower per year, although those results are preliminary. No other published studies have revealed collision

fatalities at freestanding towers, including freestanding meteorology towers at wind power sites (W. Erickson personal communication, Kerns and Kerlinger 2004).

The last risk factor that has been implicated in collisions of night migrating birds with tall structures is lighting (Kerlinger 2000c). The lights of communication towers and some other structures (smoke stacks, cooling towers, and tall buildings) have been demonstrated to attract migrants that then collide with the structures. On the 1,000-foot tall communication towers where large fatality events have occurred, all have been equipped with up to twelve steady-burning red L-810 obstruction lights as well as several flashing L-864 red flashing strobe-like lights (often incandescent lights that do not go entirely black between flashes).

The lighting on wind turbines is very different (see FAA Advisory Circular). Wind turbines rarely have the steady-burning red lights (L-810 obstruction lights) that are present on communication towers. Instead, a subset of turbines (usually one in three-four) has single flashing L-864 red flashing strobes. A few turbines at Buffalo Ridge in Minnesota have steady red lighting, as do all of the lighted turbines at the Erie Shores Wind Farm.

Research by Kerns and Kerlinger (2004) and Kerlinger (2004a, 2004b, Kerlinger et al. in review) has not demonstrated any large-scale fatality events at wind turbines, nor has it shown any difference in numbers of fatalities at lit versus unlit turbines. Similar results from wind plants in Washington, Oregon, and Minnesota have supported this finding. At the Mountaineer Wind Energy Facility in West Virginia, Kerns and Kerlinger (2004) reported a fatality event involving about 30 night migrating songbirds in May 2003. That event occurred on a very foggy night at an electrical substation involving mostly one turbine and the substation fencing. Birds were apparently attracted to four sodium vapor lamps on the substation and collided with the three closest turbines (mostly the closest turbine) and the substation infrastructure. Almost no birds were found at the 41 other turbines at that project, despite 11 of them being lit with red flashing, L-864 strobe-like lights.

At Buffalo Ridge in Minnesota, a smaller fatality event involving 14 migrants at two adjacent turbines (seven under each turbine) at Buffalo Ridge in Minnesota was probably the result of the steady burning red lights on one of the turbines. At Erie Shores, turbines with lighting (in all cases steady red) had more night migrant fatalities than unlit turbines. For this reason, Environment Canada has requested that the lighting be changed to flashing red. This suggests that steady burning red lights (L-810) can attract birds.

The fact that no large scale mortality events involving night migrating birds have been documented at wind turbines anywhere, combined with the fact that there is no difference between the numbers of birds killed at lit versus unlit wind turbines at sites across the United States, strongly suggests that FAA obstruction lighting for wind turbines (red flashing, L-864 strobe-like lights) does not have the same attractive effect as the steady burning red lights (L-810) that are on communication towers (Kerlinger 2004a, 2004b). Furthermore, the FAA does not stipulate that all wind turbines be lit. Ongoing research by Gehring at communication towers in Michigan (Gehring, Kerlinger, and Mannville 2005 – paper presented at the American Ornithologist's Union annual meeting; Gehring and Kerlinger 2007) has now provided the first evidence that L-810 lights are far more attractive than flashing L-864 lights. Tower fatalities in

Illinois have consistently been at towers in excess of 800 feet AGL, although some have exceeded 1,500 feet AGL (Seets and Bohlen 1977, Bohlen 2004, Graber 1958, Larkin and Frase 1988). These towers have all been equipped with guy wires and a combination of flashing red (L-864 type incandescent) and steady burning (L-810 type) lights. Some of these towers have been equipped with more than 12-15 lights, staggered at various levels from just above the ground to more than 1,000 feet above the ground.

For the reasons presented above – 1) relatively low height of wind turbines compared with tall communication towers, 2) lack of guy wires on wind turbines, 3) FAA lighting on wind turbines that appears not to attract nocturnal migrants, and 4) regional data documenting a broad-front, high-altitude migration – collision risk to night migrating songbirds is likely to be minimal, and fatalities are not likely to be biologically significant, at the proposed Roaring Brook site. However, fatalities of night migrants will likely be greater than at other wind sites because Roaring Brook turbines are about 25% taller and extend higher into the airspace of these migrants. Fatality studies have not been done at turbines in excess of 125 m (410 feet) so there are no data with which to compare.

6.2.2.2 Raptors

Risk factors for raptors are well documented at the Altamont Pass Wind Resource Area (APWRA; see Section 6.1.2 discussion). Table 6.2.2.2-1 compares the APWRA risk factors with the project contemplated at Roaring Brook. As will be seen, the known or suspected risk factors for raptors are minimal at the Project site.

Table 6.2.2.2-1. Comparison of Risk Factors

Known or Suspected Risk Factors Altamont Pass Wind Resource Area (APWRA)	Comparison of Risk Factors Proposed Roaring Brook Project
Large concentration of turbines (about 5,400 in 2002)	40 turbines
Lattice towers that encourage raptors to perch	Tubular towers, no perching
Fast rotating turbine blades (40-72 rpm)	Slow rotating blades (12-18 rpm)
Closely spaced turbines (less than 30 m [100 feet] apart)	Widely spaced turbines (greater than 250 m [800 feet])
Turbines in steep valleys and canyons	Turbines on gently rolling/flat terrain
Large prey base that attracts raptors	Small prey base
Turbine rotors sweep to less than 10 m (30 feet) from ground	Turbine rotors sweep down to about 53.5 m (175 feet) above the ground
High raptor and susceptible species use of area	Low raptor use of area, some nesting likely

At the Project site, collision mortality, if it were to occur, is unlikely to affect local raptor populations. The open-country species that are most often recorded in mortality studies – Red-tailed Hawk and American Kestrel – are unlikely to frequent the Project site. The raptors that

reside in the Project site's woodland occur at low densities. Turkey Vultures frequent many wind farms in the U.S., but they are rarely recorded in mortality studies.

6.2.2.3 Waterbirds (Waterfowl, Shorebirds, Etc.)

Wetland habitats are dispersed throughout the Roaring Brook site and surrounding areas. BBS data showed that all breeding waterbirds occur at low frequencies. In migration, it is unlikely that the site's wetland habitats will concentrate waterfowl or other waterbirds. In addition, there are no cropland areas adjacent to the Project site that would attract flocks of geese to feed on waste grain.

Waterbird mortality at wind farms is relatively low. In a review of bird collisions reported in 31 studies at wind-energy facilities, Erickson et al. (2001, cited in NRC 2007) reported that 5.3% of fatalities were waterfowl, 3.3% waterbirds (mainly rails and coot), and 0.7% shorebirds. Risk of waterfowl collision during migration is likely to be minimal, because most of these birds migrate at high altitudes (Kerlinger and Moore 1989, Bellrose 1980). Collision risk to shorebirds is also not particularly likely because they migrate mostly at night and at high altitudes (Kerlinger and Moore 1989). Moreover, research has demonstrated that very few shorebirds collide with wind turbines or other tall structures. Shorebirds are extremely rare on the lists of birds killed at wind plants (Erickson et al. 2001), and they are also rare at communication towers (Shire et al. 2000). Like waterfowl, they are also not known to be attracted to lights (FAA or other types).

6.2.2.4 Listed Species

Any listed species that transits the Project airspace at or near rotor height or, in the case of raptors, hunts at the Project site may be at risk of collision. Nevertheless, data sources indicate that no federal or NYS-listed appears likely to engage in these behaviors at a frequency that would lead to significant collision risk. This includes the special-concern Sharp-shinned Hawk, Cooper's Hawk, Northern Goshawk, and Red-shouldered Hawk. The NYS-threatened Bald Eagle may transit the site in migration, but these flights would be infrequent. The Project site lacks habitat for open-country birds that perform aerial courtship displays, such as the threatened Northern Harrier and Upland Sandpiper. Green List species found on site, such as Wood Thrush, are not likely to be at risk of collision because they do not fly above the canopy during most of the nesting season and when they do so, they are only a few feet above the treetops. Special Concern Species were not present on site, with the exception of American Bittern, which could be at risk when flying between wetland areas on site, if these birds forage on site regularly.

6.2.2.5 Collision Risk, Conclusions

Fatality numbers and species impacted at the Roaring Brook Project are likely to be similar, on a per turbine per year basis, to those found at Eastern and Midwestern U. S. projects that have been studied. However, fatality rates of night migrants are likely to be somewhat greater than at other sites for two reasons. First, the Roaring Brook turbines will be taller than other turbines and extend farther into the height zone of migrating birds. These fatalities, when distributed among many species, are not likely to be biologically significant. Second, the fatality rate of these birds at the nearby Maple Ridge wind power facility has been found to be slightly greater than other

sites in the eastern United States. (More comprehensive fatality rate comparisons can be made when the second year of monitoring at Maple Ridge becomes available.) Among nesting songbirds, collision risk is minimal to nil. When compared with the Altamont Pass Wind Resource Area, collision risk factors for raptors are minimal. Collision risk to night-migrating songbirds is likely to be slightly greater than at other sites examined because the turbines at Roaring Brook will be taller. However, because altitude of migration is generally above the sweep of the wind turbine rotors and no concentrations of these birds are to be expected above the Project site, risk is not likely to be biologically significant.

7.0 Recommendations

The following recommendations for the proposed Roaring Brook Wind Power Project are based on: 1) an on-site examination of the habitat and birdlife, and 2) literature and database searches regarding the Project site's avifauna and what is known about the potential risks to birds from wind-power development in the United States and Europe.

- Electrical lines within the project site should be underground between the turbines. Any new aboveground lines from the site and substations to transmission lines should follow Avian Power Line Interaction Committee (APLIC) guidelines for insulation and spacing.

- Permanent meteorology towers should be freestanding (i.e., without guy wires) to prevent the potential for avian collisions.

- Utilize previously disturbed areas on site for turbine locations and other infrastructure.

- Size of roads and turbine pads should be minimized in order to disturb as little habitat as possible. This may be accomplished by consolidating road and interconnect routing. IN addition, after construction, any forest habitat should be permitted or encouraged to regenerate as close to the turbines and roads as possible in order to minimize habitat fragmentation, edge effects, and disturbance/displacement impacts.

- A long-term forest management plan, including a sustainable harvest methods, involving the landowner is recommended. The plan could be modeled after that used by The Nature Conservancy on adjoining lands. Such a plan would reduce the potential of forest fragmentation and provide a means of preserving forest interior nesting species.

- Lighting of turbines and other infrastructure (turbines, substations, buildings) should be minimal in order to reduce the potential for attraction of night migrating songbirds and similar species. Federal Aviation Administration (FAA) lighting for night use should be flashing lights (red or white) with the longest permissible off cycle. No steady burning FAA lights should be used. Sodium vapor lamps and spotlights should not be used at any facility (e.g., lay-down areas or substations) at night except when emergency maintenance is needed.

- A nesting bird study is recommended as a means of determining species composition, the presence of Green List and other rare species, as well as providing a baseline for potential postconstruction studies of displacement impacts.

- A post-construction study of collision fatalities would provide information on the number and type of fatalities that occur, and determine the biological significance and potential for cumulative impacts of turbine development in New York State and the Eastern U.S.

8.0 References

Able, K.P. 1973. The role of weather variables in determining the magnitude of nocturnal bird migration. Ecology 54:1031-1041.

Able, K.P. 1970. A radar study of the altitude of nocturnal passerine migration. Bird-Banding 41:282-290.

Able, K.P., and S.A. Gauthreaux, Jr. 1975 Quantification of nocturnal passerine migration with a portable ceilometer. Condor 77(1):92-96.

Alerstam, T. 1993. Bird migration. Cambridge University Press, Cambridge, UK.

Andrle, R. F., and J. B. Carroll. 1988. The atlas of breeding birds in New York state. Cornell University Press, Ithaca, NY.

Anderson, R.L., D. Strickland, J. Tom, N. Neumann, W. Erickson, J. Cleckler, G. Mayorga, G. Nuhn, A. Leuders, J. Schneider, L. Backus, P. Becker, and N. Flagg. 2000. Avian monitoring and risk assessment at Tehachapi Pass and San Gorgonio Pass wind resource areas, California: Phase 1 preliminary results. Proc. National Avian-Wind Power Planning Meeting 3:31-46. Nat. Wind Coord. Committee, Washington, DC.

Anderson, R.L., M. Morrison, K. Sinclair, and M.D. Strickland. 1999. Studying wind energy/bird interactions: a guidance document. Metrics and methods for determining or monitoring potential impacts on birds at existing and proposed wind energy sites. National Wind Coordinating Committee, Washington, DC.

American Bird Conservancy. 2003. The American Bird Conservancy Guide to the 500 Most Important Bird Areas in the United States: Key Sites for Birds and Birding in All 50 States. Random House. 560 pp.

American Bird Conservancy. 2006. Most Threatened Bird Habitats in the U.S. Bird Conservation, Summer, pgs. 18-19.

Anderson, R., et al. 2000. Avian monitoring and risk assessment at Tehachapi and San Gorgonio, WRAS. Proceedings of the National Avian Wind Power Interaction Workshop III, May, 1998, San Diego, CA. National Wind Coordinating Committee/RESOLVE, Inc.

Arnett, E.B., technical editor. 2005. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of bat fatality search protocols, patters of fatality, and behavioral interactions with wind turbines. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA.

Avery, M.L., P.F. Springer, and N.S. Dailey. 1980. Avian mortality at man-made structures: an annotated bibliography. U.S. Fish & Wildlife Service, FWS/OBS-80/54.

Banks, R.C. 1979. Human related mortality of birds in the United States. Special Scientific Report, Wildlife No. 215. Washington, D.C: Fish and Wildlife Service, U.S. Department of the Interior.: 16p.

Barrios, L., and A. Rodriguez. 2004. Behavioral and environmental correlates of soaring-bird mortality at on-shore wind turbines. Journal of Appl. Ecology 41:72-81.

Bellrose, F.C. 1980. Ducks, geese, and swans of North America. Wildlife Management Institute Publication. Stackpole Books, Mechanicsburg, PA.

Berthold, 2001. Bird migration, a general survey. Oxford University Press, Oxford.

Bohlen, H.D. 2004. Towers kill migratory birds. The Living Musuem 65(4):10-13.

Bookhout, T.A., K.E. Bednarik, and R.W. Kroll. 1989. The Great Lakes marshes, Pp. 131-156. *In* Habitat management for migrating and wintering waterfowl in North America (L.M. Smith, R.L. Pederson, and R.M. Kaminski, eds.). Lubbock, TX: Texas Tech University Press.

Burger, M.F., and J.M. Liner. 2005. Important Bird Areas of New York. Audubon, New York.

Christmas Bird Count 1997-2006. National Audubon Society.

Coleman, J.S. and S.A. Temple. 1996. On the prowl. Wisconsin Natural Resources; December issue.

Cooper, B.A., C.B. Johnson, and R.J. Ritchie. 1995. Bird migration near existing and proposed wind turbine sites in the eastern Lake Ontario region. Report to Niagara Mohawk Power Corp., Syracuse, NY.

Cooper, B.A., and T.J. Mabee. 1999. Bird migration near proposed wind turbine site at Wethersfield and Harrisburg, New York. Draft Report to Niagara Mohawk Power Corp., Syracuse, NY.

Cooper, B.A., T.J. Mabee, and J.H. Plissner. 2004a. Radar studies of nocturnal migration at wind sites in the eastern U. S. Paper presented at the American Bird Conservancy-American Wind Energy Association Meeting, May 18-19, 2004, Washington, DC.

Cooper, B.A., T.J. Mabee, and J.H. Plissner. 2004b. A visual and radar study of spring bird migration at the proposed Chautauqua Wind Energy Facility, New York. Final Report. Prepared for Chautauqua Windpower, LLC, Lancaster, NY.

Cooper, B.A., A.A. Stickney, and T.J. Mabee. 2004c. A radar study of nocturnal bird migration at the proposed Chautauqua Wind Energy Facility, New York, Fall 2003. Final Report. Chautauqua Windpower, LLC, Lancaster, NY.

DeLorme. 2003. New York Atlas & Gazetteer. Yarmouth, ME.

de Lucas, M., G.F.E. Janss, and M. Ferrer. 2004. The effects of a wind farm on birds in a migration point: the Strait of Gibraltar. Biodiversity and Conservation 13:395-407.

Diehl, R.H., R.P. Larkin, and J.E. Black. 2003. Radar observations of bird migration over the Great Lakes. Auk 120:278-290.

Demastes, J.W., and J. M. Trainer. 2000. Avian risk, fatality, and disturbance at the IDWGA Windpower Project, Algona, IA. Report to Univ. N. Iowa, Cedar Falls, IA.

Drewitt, A.L., and R.H.W. Langston. 2006. Assessing the impacts of wind farms on birds. Ibis, 148: 29-42.

Eastwood, E. 1967. Radar ornithology. Methuen, London.

Ehrlich, P.R., D.S. Dobkin, and D. Wheye. 1988. The birder's handbook, a field guide to the natural history of North American birds. Simon and Shuster, New York.

Erickson, W.P., G.D. Johnson, M.D. Strickland, and K. Kronner. 2000. Avian and bat mortality associated with the Vansycle Wind Project, Umatilla County, Oregon: 1999 study year. Tech. Report to Umatilla County Dept. of Resource Services and Development, Pendleton, OR.

Erickson, W., G.D. Johnson, M.D. Strickland, K.J. Sernka, and R. Good. 2001. Avian collisions with wind turbines: a summary of existing studies and comparisons to other sources of collision mortality in the United States. White paper prepared for the National Wind Coordinating Committee, Avian Subcommittee, Washington, DC.

Erickson, W., G. Johnson, D. Young, D. Strickland, R. Good, M. Bourassa, K. Bay, and K. Sernka. 2002. Synthesis and comparison of baseline avian and bat use, raptor nesting, and mortality information from proposed and existing wind power developments. Bonneville Power Administration, Portland, OR.

Erickson, W., J. Jeffrey, K. Kronner, and K. Bay. 2003a. Stateline wind project wildlife monitoring annual report, results for the period July 2001 – December 2002. Tech. Rpt. to FPL Energy, Oregon Office of Energy, and Stateline Technical Advisory Committee.

Erickson, W., K. Kronner, and B. Gritski. 2003b. Nine Canyon Wind Power Project avian and bat monitoring report. September 2002-August 2003. Prepared for Nine Canyon Technical Advisory Committee and Energy Northwest.

Erickson, W.P., J. Jeffrey, K. Kronner, and K. Bay. 2004. Stateline Wind Project Wildlife Monitoring Report: July 2001 – December 2003. Prepared for FPL Energy, stateline Technical Advisory Committee, Oregon Department of energy, by Western EcoSystems Technology, Inc. Cheyenne, WY and Ealla Walla, WA; and Northwest Wildlife Consultants, Inc., Pendleton, OR. December 2004.

Erickson, W.P., G.D. Johnson, and D.P. Young. 2005. A Summary and Comparison of Bird Mortality from Anthropogenic Causes with an Emphasis on Collisions. USDA Forest Service General Technical Report PSW-GTR-191.

Everaert, J. 2002 unpublished. Wind turbines and birds in Flanders (Belgium): Preliminary study results.

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. Report prepared for Tennessee Valley Authority.

Gauthreaux, S.A., Jr. 1972. A radar and direct visual study of passerine spring migration in southern Louisiana. Auk 88: 343-365.

Gauthreaux, S.A., Jr. 1972 Behavioral responses of migrating birds to daylight and darkness: A radar and direct visual study. Wilson Bull. 84:136-148..

Gauthreaux, S.A., Jr. 1980. Direct visual and radar methods for detection, quantification, and prediction of bird migration. Dept. of Zoology, Clemson University, Clemson, SC.

Gehring, J., and P. Kerlinger 2007a. Avian collisions at communication towers: I. The role of tower height and guy wires. Report to the Michigan Attorney General Office, Lansing, MI.

Gehring, J., and P. Kerlinger 2007b. Avian collisions at communication towers: II. The role of Federal Aviation Administration obstruction lighting systems. Report to the Michigan Attorney General Office, Lansing, MI.

Gehring, J.L., P. Kerlinger, and A.M. Manville, II. 2006. The relationship between avian collisions and communication towers and nighttime tower lighting systems and tower heights. Draft summary report to the Michigan State Police, Michigan Attorney General, Federal Communications Commission, and U.S. Fish and Wildlife Service. 19 pp.

Graber, R.R. 1958. Nocturnal migration in Illinois – different points of view. Wilson Bulletin 80:36-71.

HMANA, Hawk Migration Studies (The Journal of the Hawk Migration Association of North America). 1996-2002 and other volumes.

Heintzelman, D.S. 1975. Autumn hawk flights, the migrations in eastern North America. Rutgers University Press, New Brunswick, NJ. pp. 398.

Heintzelman, D.S. 1986. The migrations of hawks. Indiana University Press, Bloomington, IN. 369 pp.

Hodson, N.L. and D.W. Snow. 1965. The road deaths enquiry, 1960-61. Bird Study 9:90-99.

Howell, J. 1997. Bird mortality at rotor swept area equivalents, Altamong Pass and Montezuma Hills, California. Trans. West. Sect. Wildl. Soc. 33:24-29.

Howell, J.A., and J.E. DiDonato. 1991. Assessment of avian use and mortality related to wind turbine operations, Altamont Pass, Alameda and Contra Costa counties, California, Sept. 1988 through August 1989. Final Rept. for Kenetech Windpower, San Francisco, CA.

Howe, R.W., W. Evans, and A.T. Wolf. 2002. Effects of wind turbines on birds and bats in northeastern Wisconsin. Report to Wisconsin Public Service Corporation and Madison Gas and Electric Company.

Howell, J. A. 1997. Avian mortality at rotor swept area equivalents, Altamont Pass and Montezuma Hills, CA. Report to Kenetech Windpower, Livermore, CA.

Howell, J.A., and J.E. DiDonato. 1991. Assessment of avian use and mortality related to wind turbine operations, Altamont Pass, Alameda and Contra Costa counties, California, Sept. 1988 through August 1989. Final Rept. for Kenetech Windpower, San Francisco, CA.

Howe, R.W., and R. Atwater 1999. The potential effects of wind power facilities on resident and migratory birds in eastern Wisconsin. Report to the Wisconsin Dept. of Natural Resources, Bureau of Integrated Science Services, Monona, WI.

Howe, R.W., W. Evans, and A.T. Wolf. 2002. Effects of Wind Turbines on Birds and Bats in Northeastern Wisconsin. Prepared by University of Wisconsin-Green Bay, for Wisconsin Public Service Corporation and Madison Gas and Electric Company, Madison, WI.

Hunt, G. 2002. Golden Eagles in a perilous landscape: predicting the effects of mitigation for wind turbine blade-strike mortality. Report to California Energy Commission, Sacramento, CA. PierP500-02-043F

Ihde, S., and E. Vauk-Henzelt. 1999. Vogelschutz und Windenergie. Bundesverband WindEnergie e.V., Osnabruck, Germany.

Jacobs, M. 1995. Paper presented to the Windpower 1994 Annual meeting.

Jain, A.A. 2005. Bird and bat behavior and mortality at a northern Iowa windfarm. M.S. Thesis. Iowa State University, Ames, IA. (submitted for publication).

Jain, A.A., P. Kerlinger, R. Curry, and L. Slobodnik. 2007. Annual report for the Maple Ridge Wind Power Project, postconstruction bird and bat fatality study - 2006. Report to PPM Energy and Horizon Energy.

James, R.D. no date. Bird observations at the Pickering Wind Turbine. Unpublished report.

James, R.D., and G. Coady. 2003. Exhibition Place wind turbine bird monitoring program in 2003. Report to Toronto Hydro Energy Services, Toronto, CA.

Janss, G. 2000. Bird behavior in and near a wind farm at Tarifa, Spain: management considerations. Proc. National Avian - Wind Power Planning Meeting III, San Diego, CA, May 1998. National Wind Coordinating Committee, Washington, DC.

Johnson, G.D., D.P. Young, Jr., W.P. Erickson, M.D. Strickland, R.E. Good, and P. Becker. 2000. Avian and bat mortality associated with the initial phase of the Foote Creek Rim Windpower Project, Carbon County, Wyoming: November 3, 1998-October 31, 1999. Report to SeaWest Energy Corp. and Bureau of Land Management.

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

Johnson, G.D., W. Erickson, J. White, and R. McKinney. 2003. Avian and bat mortality during the first year of operation at the Klondike Phase I Wind Project, Sherman County, Oregon. Draft report to Northwestern Wind Power.

Kerlinger. P. 1982. The migration of Common Loons through eastern New York. Condor 84:97-100.

Kerlinger, P. 1989. Flight strategies of migrating hawks. University of Chicago Press, Chicago, IL. pp. 389.

Kerlinger, P. 1995. How birds migrate. Stackpole Books, Mechanicsburg, PA. pp. 228.

Kerlinger, P. 2000a. An Assessment of the Impacts of Green Mountain Power Corporation's Wind Power Facility on Breeding and Migrating Birds in Searsburg, Vermont. Proceedings of the National Wind/Avian Planning Meeting, San Diego, CA, May 1998.

Kerlinger, P. 2000c. Avian mortality at communications towers: a review of recent literature, research, and methodology. Report to the U. S. Fish and Wildlife Service. www.fws.gov/r9mbmo

Kerlinger, P. 2001. Avian mortality study at the Green Mountain Windpower Project, Garrett, Somerset County, Pennsylvania - 2000-2001.

Kerlinger, P. 2002a. Avian fatality study at the Madison Wind Power Project, Madison, New York. Report to PG&E Generating.

Kerlinger, P. 2002b. An Assessment of the Impacts of Green Mountain Power Corporation's Wind Power Facility on Breeding and Migrating Birds in Searsburg, Vermont. Report to National Renewable Energy Laboratory, US Dept. of Energy, Golden, CO.

Kerlinger, P. 2004a. Wind turbines and avian risk: lessons from communication towers. Presented at the American Bird Conservancy-American Wind Energy Association Meeting, May 18-19, 2004, Washington, DC.

Kerlinger, P. 2004b. Attraction of night migrating birds to FAA and other types of lights. National Wind Coordinating Committee – Wildlife Working Group Meeting, November 3-4, 2004, Lansdowne, VA.

Kerlinger, P. 2005. A test of the hypothesis that night migrating birds follow Appalachian Ridges. Paper presented at the Joint Meeting of the Wilson Ornithological Society and Association of Field Naturalists, April 2005, Beltsville, MD.

Kerlinger, P., V.P. Bingman, and K.P. Able. 1985. Comparative flight behaviour of migrating hawks studied with tracking radar during autumn in central New York. Canadian Journal of Zoology 63:755-761.

Kerlinger, P., R. Curry, A. Hasch, and J. Guarnaccia. 2007. Migratory bird and bat monitoring study at the Crescent Ridge wind power project, Bureau County, Illinois: September 2005-August 2006. Report to Orrick, Herrington, and Sutcliffe, LLP. Washington, DC.

Kerlinger, P., R. Curry, L. Culp, A. Jain, C. Wilderson, B. Fischer, and A. Hasch. 2006. Post-construction avian and bat fatality monitoring study for the High Winds Wind Power Project, Solano County, California: Two Year Report. Prepared for High Winds, LLC and FPL Energy, Livermore, CA.

Kerlinger, P., and R. Curry. 1997. Analysis of Golden Eagle and Red-tailed Hawk fatalities on Altamont ownership property within the Altamont Wind Resource Area (AWRA). Report prepared as part of the Altamont Avian Plan for Altamont Ownership Consortium.

Kerlinger, P., and J. Kearns. 2003. FAA lighting of wind turbines and bird collisions. Proceedings of the National Wind Coordinating Committee Meeting, November 18, 2003, Washington, DC.

Kerlinger, P., and F. R. Moore. 1989. Atmospheric structure and avian migration. In Current Ornithology, vol. 6:109-142. Plenum Press, NY.

Kerns, J., and P. Kerlinger. 2004. A study of bird and bat collision fatalities at the Mountaineer Wind Energy Center, Tucker County, West Virginia: Annual report for 2003. Report to FPL Energy and the MWEC Technical Review Committee.

Klem, D., Jr. 1990. Collisions between birds and windows: mortality and prevention. Journal of Field Ornithology 61(1): 120-128.

Knight, F., and M. Wilson. 1998. New York Wildlife Viewing Guide. Falcon Press, Helena, MT.

Koford, R., A. Jain, G. Zenner, and A. Hancock. 2004. Avian mortality associated with the Top of Iowa Wind Power Project. Progress Report: Calendar Year 2003. Iowa State University, Ames, IA.

Koford, R., A. Jain, G. Zenner, and A. Hancock. 2005. Avian mortality associated with the Top of Iowa Wind Power Project. Report to Iowa Department of Natural Resources.

Koops, F.B.J. 1987. Collision victims of high-tension lines in the Netherlands and effects of marking. KRMA Report 01282-MOB 86-3048.

Larkin, R.P., and B.A. Frase. 1988. Circular paths of birds flying neare a broadcasting tower in cloud. J. Comp. Psychology 102:90-93.

Larsen, J.K., and J. Madsen. 2000. Effects of wind turbines and other physical elements on field utilization by pink-footed geese (*Anser brachyrhynchus*): A landscape perspective. Landscape Ecology 15:755-764.

Leddy, K., K. F. Higgins, and D. E. Naugle. 1999. Effects of wind turbines on upland nesting birds in conservation reserve program grasslands. Wilson Bulletin 111:100-104.

Lekuona, J.M. 2001. Uso del espacio por la avifauna y control de la mortalidad de aves y murciélagos en los parques eólicos de Navarra durante un ciclo anual. Dirección General de Medio Ambiente, Departamento de Medio Ambiente, Ordenación de Territorio y Vivienda, Gobierno de Navarra.

Levine, E. 1998. Bull's birds of New York State. Cornell University Press, Ithaca, NY.

Lowther, S. 2000. The European perspective: some lessons from case studies. Proc. National Avian - Wind Power Planning Meeting III, San Diego, CA, May 1998. National Wind Coordinating Committee, Washington, DC.

Marti Montes, R., and L. Barrios Jaque. 1995. Effects of wind turbine power plants on the Avifauna in the Campo de Gibraltar Region. Spanish Ornithological Society.

Martin, E.M., and P.I. Padding. 2002. Preliminary estimates of waterfowl harvest and hunter activity in the United States during the 2001 hunting season. United States Fish and Wildlife Service Division of Migratory Bird Management, Laurel, MD.

National Research Council, Committee on Environmental Impacts of Wind Energy Projects. 2007. Environmental Impacts of Wind-Energy Projects. The National Academies Press, Washington, D.C.

North American Waterfowl Management Plan. 2004. North American waterfowl management plan: strengthening the biological foundation (Implementation Framework). U.S. DOI, Fish and Wildlife Service and Environment Canada, Canadian Wildlife Service. 126 pp.

Nicholson, C. P. 2003. Buffalo Mountain Windfarm Bird and Bat Mortality Monitoring Report: October 2000 – September 2002. Tennessee Valley Authority, Knoxville, TN.

Orloff, S. 1992. Tehachapi Wind Resourc Area avian collision baseline study. Prepared for California Energy Commission, Sacramento, CA. 33 pp.

Orloff, S., and A. Flannery. 1992. Wind turbine effects on avian activity, habitat use, and mortality in Altamont Pass and Solano County wind resource areas, 1989-1991. California Energy Commission, Sacramento, CA.

Orloff, S., and A. Flannery. 1996. A continued examination of avian mortality in the Altamont Pass wind resource area. California Energy Commission, Sacramento, CA.

Pedersen, M.B., and E. Poulsen. 1991. Impact of a 90 m/2MW wind turbine on birds – avian responses to the implementation of the Tjaereborg wind turbine at the Danish Wadden Sea. Dansek Vildundersogelser, Haefte 47. Miljoministeriet & Danmarks Miljoundersogelser.

Percival, S. 1998. Birds and wind turbines: managing potential planning issues. In Proc. Of the 20th British Wind Energy Association Conference, p. 345-350.

Price J. and P. Glick. 2002. The Birdwatchers Guide to Climate Change. National Wildlife Federation and American Bird Conservancy. (http://www.abcbirds.org/climatechange/birdwatchersguide.pdf)

Rich, T.D., C.J. Beardmore, H. Berlanga, P.J. Blancher, M.S.W. Bradstreet, G.S. Butcher, D.W. Demarest, E.H. Dunn, W.C. Hunter, E.E. Iñigo-Elias, J.A. Kennedy, A.M. Martell, A.O. Panjabi, D.N. Pashley, K.V. Rosenberg, C.M. Rustay, J.S. Wendt, T.C. Will. 2004. Partners in Flight North American Landbird Conservation Plan. Cornell Lab of Ornithology. Ithaca, NY.

Roth, R. R., M. S. Johnson, and T. J. Underwood. 1996. Wood Thrush (*Hylocichla mustelina*). *In* The Birds of North America, No. 246 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.

Seets, J.W., and H.D. Bohlen. 1977. Comparative mortality of birds at television towers in central Illinois. Wilson Bulletin 89:422-433.

Shire, G.G., K. Brown, and G. Winegrad. 2000. Communication towers: a deadly hazard to birds. American Bird Conservancy, Washington, DC.

Sibley, D.A. 2000. The Sibley Guide to Birds. Chanticleer Press, Inc., New York, NY.

Thelander, C.G., and L. Rugge. 2000. Avian risk behavior and fatalities at the Altamont Wind Resource Area. US DOE, National Renewable Energy Laboratory SR-500-27545, Golden, CO.

Trapp, J. L. 1998. Bird kills at towers and other man-made structures: an annotated partial bibliography (1960-1998). U. S. Fish and Wildlife Service web report: www.fws.gov/r9mbmo.

Winkelman, J. E. 1990. Disturbance of birds by the experimental wind park near Oosterbierum (Fr.) during building and partly operative situations (1984-1989). RIN-

report 90/9, DLO. Institute for Forestry and Nature Research, Arnhem.

Weidner, D.S., P. Kerlinger, D.A. Sibley, P. Holt, J. Hough, and R. Crossley. 1992. Visible morning flight of neotropical landbird migrants at Cape May, New Jersey. Auk 109:500-510.

Wells, J. V. 1999. Important bird areas in New York State. National Audubon Society, New York, NY.

Winkelman, J. E. 1995. Bird/wind turbine investigations in Europe. Proceedings of National Avian-Wind Planning Meeting, Denver, CO, July 1994. Pp. 110-119. (see other references and summaries within this Proceedings volume).

Young, E.A., G. Wiens, and M. Harding. 2000. Avian surveys for the wind turbine site and the Jeffrey Energy Center, Western Resources, Pottawatomie County, Kansas, October 1998-October 1999. Project #KRD-9814. Prepared for Western Resources, Inc. and Kansas Electric Utilities Research Program.

Young, D.P., Jr., and W. Erickson. 2006. Wildlife issue solutions: What have marine radar surveys taught us about avian risk assessment? Paper presented to Wildlife Workgroup Research Meeting VI, National Wind Coordinating Collaborative, November 14-16, 2006, San Antonio, TX.

Young, E.A., G. Wiens, and M. Harding. 2000. Avian surveys for the wind turbine site and the Jeffrey Energy Center, Western Resources, Pottawatomie County, Kansas, December 1998-December 1999. Project #KRD-9814. Prepared for Western Resources, Inc. and Kansas Electric Utilities Research Program.

Young, D.P., Jr., G.D. Johnson, W.P. Erickson, M.D. Strickland, R.E. Good, and P. Becker. 2001. Avian and Bat Mortality Associated with the Initial Phase of the Foote Creek Rim Windpower Project, Carbon County, Wyoming: November 1998-October 31, 2000. Prepared for SeaWest Windpower, Inc., San Diego, CA, and Bureau of Land Management, Rawlins District Office, Rawlins, WY, by Western EcoSystems Technology, Inc., Cheyenne, WY.

Young, D.P., Jr., W.P. Erickson, R.E. Good, M.D. Strickland, and G.D. Johnson. 2003. Avian and bat mortality associated with the Initial Phase of the Foote Creek Rim Windpower Project, Carbon County, Wyoming: November 1998 – March 2002. Report to Pacific Corp, Inc., Portland, OR, SeaWest Windpower, Inc., San Diego, CA, and Bureau of Land Management, Rawlins District Office, Rawlins, WY, by Western EcoSystems Technology, Inc., Cheyenne, WY.

Young, D.P., Jr., J.D. Jeffrey, W.P. Erickson, K. Bay, K. Kronner, B. Gritski, and J. Baker. 2005. Combine HillsTurbine Ranch Wildlife Monitoring First Annual Report: March 2004-March 2005. Prepared for Eurus Energy America Corporation, Umatilla County, and the Combine Hills Technical Advisory Committee.

Zalles, J.I., and K.L. Bildstein. 2000. Raptor Watch: A Global Directory of Raptor Migration Sites. Hawk Mountain Sanctuary Association.

Appendix A. Conformance with U. S. Fish and Wildlife Service (USFWS) Guidelines

This addendum addresses the U.S. Fish and Wildlife Service's *Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines* (USFWS 2003). The Federal Register published these guidelines in July 2003, and USFWS briefed the National Wind Coordinating Committee on them on July 29, 2003. USFWS has emphasized that the guidelines are interim and voluntary. In April 2004, USFWS Director Williams sent a letter to the Service's state offices directing them regarding the implementation of the guidance document and its recommendations. The guidance document was posted on the Federal Register and a comment period was opened in July 2003 and closed in July 2005. The guidance document has now been reviewed by the public and avian experts outside of the USFWS, but the USFWS has not revised the document based on public comments and peer review.

It should be noted that the risk assessment conducted for the Roaring Brook Project relied on procedures similar to those presented in the USFWS voluntary and interim guidelines, as well as other procedures, some of which exceed what is usually requested by USFWS. For many years, the standard Phase I Avian Risk Assessment process has incorporated most of the guidelines and recommendations made by USFWS, particularly those that have been shown to be scientifically valid. Therefore, the risk assessment presented above fulfills the intent of the guidance document and follows its recommendations in order to avoid or minimize impacts to wildlife, specifically birds and their habitats.

Specific Conformance to Guidelines

Teaming With Agencies. Letters were sent to the New York State Department of Environmental Protection (DEC) and to USFWS requesting information on listed species and species of special concern, as well as other bird information. The response from the NYSDEC may be found in Appendix D. The USFWS no longer responds to these types of information requests, so the USFWS website for New York State was examined (Appendix D). Approaching these agencies meets the recommendation by USFWS that developers should attempt to team or involve such agencies in the site evaluation process. There does not appear to be a federal permitting nexus for the Roaring Brook Project with respect to wildlife. If work within wetlands is required for roads or turbine locations, a federal nexus may occur through the U.S. Army Corps of Engineers (USACOE), which often defers to USFWS with respect to wildlife issues.

Reference Sites. The Roaring Brook Wind Power Project was compared to other wind power facilities in the United States, including projects in the Midwest and East, as well as projects in the western United States, Canada, and Europe. Selecting a worst-case scenario site for comparison with the Project site was not possible because choosing such sites would necessitate tenuous assumptions about high risk to birds at wind power projects that have not been demonstrated. Selection of a worst-case scenario site at this time cannot be based on biologically documented impacts. None of the other wind power projects in the United States, with the possible exception of the APWRA of California, have resulted in biologically significant impacts to birds. In terms of collision risk to birds, comparisons made suggest that risk at the Roaring Brook site would be, in all likelihood, no greater than at other wind power facilities in the United States.

While it is not possible to compare the Roaring Brook Project with a site that could be construed as worst-case scenario, comparisons to the APWRA and sites where risk has been documented to be negligible were made. Clearly, the Roaring Brook Project does not have the collision risk factors present in the APWRA (see Table 6.2.2.2-1). Further comparisons were made to the impacts of communication towers of various sizes, lighting specifications, and construction types (guyed versus unguyed). This type of comparison is particularly important because there is a large body of research on communication towers, including towers in the eastern and Midwestern United States.

The potential for biologically significant fatalities at wind power facilities was assessed by comparing numbers of likely fatalities at the Roaring Brook Project with the hundred-plus millions of bird fatalities permitted by the USFWS via depredation, hunting, and falconry permits. Some of the species permitted to be harvested have much smaller populations than those killed by wind turbines. In other cases, the harvested species have experienced long-term declines, yet the harvests are not considered to be deleterious (significant) to the populations of these species. This comparison strongly suggests that impacts of wind turbines – estimated at tens of thousands of bird fatalities per year nationally – are not biologically significant. These comparisons are relevant because they provide actual numbers of takings permitted by the USFWS and various state agencies.

With respect to habitat disturbance and displacement of nesting birds, comparisons were made with various sites where such disturbance has been determined to occur. Because these types of impacts are likely to occur among some forest interior-nesting species at the Roaring Brook Project site, further research has been recommended to prevent or mitigate impacts.

Alternate Sites. In the case of the Roaring Brook Project, there are problems with requiring an alternative site analysis. No alternative sites were available for this study, because the habitat for several miles surrounding the Project is very similar and likely to support a similar avian community. It should also be noted that if no federal permits are necessary for this project, alternatives analysis is not required. Because a NEPA review is not triggered, an alternative sites analysis is not required. The Phase I Avian Risk Assessment did, however, compare potential impacts at the Roaring Brook Project to other wind power projects.

Checklists. Instead of using the PII and checklists supplied in the USFWS guidelines, the Phase I assessment included detailed descriptions of the habitat and topography of the site and surrounding areas. For example, the risk assessment included determination of actual or potential migration pathways and the presence of ecological magnets and/or other attractive habitats located within or adjacent to the Project boundary. This included descriptions of the habitats, wildlife and natural areas, degree of habitat fragmentation, and degree of landscape alteration, by farming and other land use practices, within and around the site that could influence avian impacts potentially resulting from the proposed development.

Regarding other specific guidance and recommendations, in the area of site development, the Phase I Avian Risk Assessment covers the following concerns:

- Letters of inquiry were sent to USFWS and DEC requesting records of listed species. In addition, habitat was examined to determine whether listed avian species are likely to nest or use the site.
- The Roaring Brook site is not located on a known, specific migration corridor for hawks, songbirds, shorebirds, waterfowl or other migrants. In addition, it has not been demonstrated that wind turbines produce biologically significant impacts on migrating birds. The Phase I assessment explains this.
- Raptor use of the area appears to be low, and topography is fairly flat, so setbacks from soaring and updraft locations do not appear to be applicable. Raptor fatalities at wind power projects outside of the 5,400 turbine APWRA have totaled very few birds. Even in the APWRA, mortality does not appear to be biologically significant. It should be noted that none of the turbines at the Roaring Brook site would be at the edge of steep terrain that could be used for soaring.
- The USFWS recommendation to configure turbines in ways that would avoid potential mortality has not been demonstrated empirically to reduce or prevent impact, because fatality numbers are small to begin with.
- Habitat fragmentation issues have been addressed in this risk assessment.
- Greater Prairie-Chickens are not present at the Roaring Brook site. Disturbance or displacement effects on them and other grassland nesting species have been addressed in the Phase I assessment.
- Road areas and habitat restoration are addressed in this risk assessment.
- Carrion availability is not applicable at the Project site.

Regarding wind turbine design and operation, many of the USFWS recommendations are either covered in this risk assessment or routinely done at modern wind plants. Some USFWS recommendations, however, are incorrect or not applicable.

- Tubular (unguyed) towers will be used to prevent perching.
- Permanent meteorology towers have been recommended to be free-standing, without guy wires, in the risk assessment.
- The USFWS recommendation that only white strobes should be used at night to avoid attracting night migrants is only partially correct. That red lights should be avoided is also only partially correct. There is strong evidence (Kerlinger 2004a, 2004b) that, in the absence of steady burning red L-810 lights, red strobe-like Federal Aviation Administration (FAA) lights do not attract birds to wind turbines. Red strobe-like lights (L-864) are likely to be recommended by the FAA for the Roaring Brook Project. This has been addressed in detail in the text of this risk assessment.
- Adjustment of tower/rotor height is problematic and cannot be addressed in this report. However, the turbines that are proposed are less than 500 feet in height and, therefore, unlikely to cause large-scale fatality events, such as those at tall communication towers. Such turbines have not been documented to cause biologically significant impacts to migrants.
- Underground electric lines and APLIC guidelines have been recommended in the risk assessment.

- Seasonal concentrations of birds are addressed in the risk assessment. The appropriateness of shutting down turbines or other mitigation is dependent on the level of demonstrated impacts, which cannot be determined during the preconstruction phase.
- The USFWS guidance document stipulates that radar or other remote sensing methodologies should be used if large concentrations of night migrants are suspected. A detailed discussion of the geographic and topographic patterns of migration is presented in this Phase I assessment. This discussion provides strong evidence that concentrated migration does not occur at the Project site. Thus, there is no scientific reason to suspect that there will be any concentration of night migrants at the Project site. Therefore, radar or other remote sensing is not recommended.
- Post-construction fatality monitoring would provide a means of determining the Project's impact to birds and has been recommended in this risk assessment.

Overall, the USFWS's interim and voluntary guidance document promises to provide a means of evaluating wind power sites for wildlife impacts. Some of the guidance and recommendations are integral to adequately assessing risk, although some have not been substantiated or are only partially correct. The guidance and recommendations set forth by USFWS are in need of a thorough peer review by the scientific community, industry, and environmental organizations prior to being required for wind power projects. Most importantly, there is need to validate the recommendations and protocols for ranking sites as to potential risk. Until such validation has been completed, it is difficult to determine how valuable the guidance and recommendations document is.

Appendix B. Photographs of representative habitats at the proposed Roaring Brook Project site, Lewis County, New York.

Appendix B. Photographs of representative habitats at the proposed Roaring Brook Project site, Lewis County, New York.

Appendix C. Birds observed during site visit on May 22-23, 2007 (Species listed by DEC are highlighted, see Table 4.1-1; * = ABC Green List, see Section 4.1 discussion).

Canada Goose
Wood Duck
Ruffed Grouse
Wild Turkey
American Bittern (SC)
Great Blue Heron
Green Heron
Turkey Vulture
Killdeer
Spotted Sandpiper
Mourning Dove
Yellow-billed Cuckoo
Black-billed Cuckoo
Belted Kingfisher
Yellow-bellied Sapsucker
Downy Woodpecker
Hairy Woodpecker
Northern Flicker
Pileated Woodpecker
Alder Flycatcher
Least Flycatcher
Eastern Phoebe
Great-crested Flycatcher
Yellow-throated Vireo
Blue-headed Vireo
Red-eyed Vireo
Blue Jay
American Crow
Common Raven
Tree Swallow
Black-capped Chickadee
Red-breasted Nuthatch
House Wren
Winter Wren
Eastern Bluebird
Veery

Hermit Thrush
Wood Thrush*
American Robin
Gray Catbird
Blue-winged Warbler
Chestnut-sided Warbler
Magnolia Warbler
Black-throated Blue Warbler
Yellow-rumped Warbler
Black-throated Green Warbler
Blackburnian Warbler
Black-and-white Warbler
American Redstart
Ovenbird
Northern Waterthrush
Mourning Warbler
Common Yellowthroat
Canada Warbler*
Scarlet Tanager
Eastern Towhee
Chipping Sparrow
Song Sparrow
Swamp Sparrow
White-throated Sparrow
Dark-eyed Junco
Northern Cardinal
Rose-breasted Grosbeak
Red-winged Blackbird
Common Grackle
Brown-headed Cowbird
Purple Finch
American Goldfinch

68 Species

Appendix D. Letters to EDR from the USFWS and NYSDEC regarding listed species at or near the proposed Roaring Brook Wind Power Project, Lewis County, New York.

New York State Department of Environmental Conservation
Division of Fish, Wildlife & Marine Resources
New York Natural Heritage Program
625 Broadway, Albany, New York 12233-4757
Phone: (518) 402-8935 • **FAX:** (518) 402-8925
Website: www.dec.state.ny.us

S. S.

Alexander B. Grannis
Commissioner

April 24, 2007

Sara R. Stebbins
Environmental Design & Research
238 West Division Street
Syracuse, NY 13204

MAY 1 0 REC'D
EDR, P.C.

Dear Ms. Stebbins:

In response to your recent request, we have reviewed the New York Natural Heritage Program database with respect to an Environmental Assessment for the proposed Roaring Brook Wind Power Project #07025, area as indicated on the map you provided, located in the Town of Martinsburg, Lewis County.

Enclosed is a report of rare or state-listed animals and plants, significant natural communities, and other significant habitats, which our databases indicate occur, or may occur, on your site or in the immediate vicinity of your site. The information contained in this report is considered sensitive and should not be released to the public without permission from the New York Natural Heritage Program.

PLEASE NOTE: For Windpower Projects, we report all records found within the project boundary, and any avian records that may be located within a 10-mile buffer of the project boundary. We also report Indiana bat hibernaculum that may be located within a 40-mile buffer of the project boundary.

PLEASE NOTE: The Tug Hill Wildlife Management Area is adjacent to the Western edge of the project boundary.

The presence of the plants and animals identified in the enclosed report may result in this project requiring additional review or permit conditions. For further guidance, and for information regarding other permits that may be required under state law for regulated areas or activities (e.g., regulated wetlands), please contact the appropriate NYS DEC Regional Office, Division of Environmental Permits, at the enclosed address.

For most sites, comprehensive field surveys have not been conducted; the enclosed report only includes records from our databases. We cannot provide a definitive statement on the presence or absence of all rare or state-listed species or significant natural communities. This information should not be substituted for on-site surveys that may be required for environment impact assessment.

Our databases are continually growing as records are added and updated. If this proposed project is still under development one year from now, we recommend that you contact us again so that we may update this response with the most current information.

Sincerely,

Tara Seoane

Tara Seoane, Information Services
NY Natural Heritage Program

Encs.

cc: Reg. 6, Wildlife Mgr.
Mark Wothai, Bureau of Habitat, Albany
Rudyard Edick, Environmental Permits, Albany

Natural Heritage Report on Rare Species

NY Natural Heritage Program, NYS DEC, 625 Broadway, 5th Floor, Albany, NY
12233-4757
(518) 402-8935

-This report contains SENSITIVE information that should not be released to the public without permission from the NY Natural Heritage Program.
-Refer to the User's Guide for explanations of codes, ranks and fields.
-We do not provide maps for species most vulnerable to disturbance.

Natural Heritage Report on Rare Species and Ecological Communities

MAMMALS

Myotis leibii
Eastern Small-footed Myotis

				Office Use
NY Legal Status:	Special Concern	**NYS Rank:**	S2 - Imperiled	5161
Federal Listing:		**Global Rank:**	G3 - Vulnerable	
County:	Jefferson			
Town:	Watertown			S
Location:	Documented beyond the boundaries of the project site. For information on the population at this location and management considerations, please contact the NYS DEC Regional Wildlife Manager for the Region where the project is located, or the NYS DEC Endangered Species Unit at 518-402-8859.			

Myotis leibii
Eastern Small-footed Myotis

				Office Use
NY Legal Status:	Special Concern	**NYS Rank:**	S2 - Imperiled	4294
Federal Listing:		**Global Rank:**	G3 - Vulnerable	
County:	St. Lawrence			
Town:	Rossie			S
Location:	Documented beyond the boundaries of the project site. For information on the population at this location and management considerations, please contact the NYS DEC Regional Wildlife Manager for the Region where the project is located, or the NYS DEC Endangered Species Unit at 518-402-8859.			

Myotis sodalis
Indiana Bat

				Office Use
NY Legal Status:	Endangered	**NYS Rank:**	S1 - Critically imperiled	3122
Federal Listing:	Endangered	**Global Rank:**	G2 - Imperiled	ESU
County:	Jefferson			USFWS
Town:	Watertown			S
Location:	Documented beyond the boundaries of the project site. For information on the population at this location and management considerations, please contact the NYS DEC Regional Wildlife Manager for the Region where the project is located, or the NYS DEC Endangered Species Unit at 518-402-8859.			

Myotis sodalis
Indiana Bat

				Office Use
NY Legal Status:	Endangered	**NYS Rank:**	S1 - Critically imperiled	12377
Federal Listing:	Endangered	**Global Rank:**	G2 - Imperiled	ESU
County:	Jefferson			USFWS
Town:	Le Ray			
Location:	Documented beyond the boundaries of the project site. For information on the population at this location and management considerations, please contact the NYS DEC Regional Wildlife Manager for the Region where the project is located, or the NYS DEC Endangered Species Unit at 518-402-8859.			

These bat occurrences are within 40 miles of the project site.

Natural Heritage Report on Rare Species and Ecological Communities

					Office Use
Myotis sodalis **Indiana Bat**	**NY Legal Status:**	Endangered	**NYS Rank:**	S1 - Critically imperiled	11647
	Federal Listing:	Endangered	**Global Rank:**	G2 - Imperiled	ESU
	County:	Jefferson			USFWS
	Town:	Watertown, Adams			
	Location:	Documented beyond the boundaries of the project site. For information on the population at this location and management considerations, please contact the NYS DEC Regional Wildlife Manager for the Region where the project is located, or the NYS DEC Endangered Species Unit at 518-402-8859.			

					Office Use
Myotis sodalis **Indiana Bat**	**NY Legal Status:**	Endangered	**NYS Rank:**	S1 - Critically imperiled	11657
	Federal Listing:	Endangered	**Global Rank:**	G2 - Imperiled	ESU
	County:	Jefferson			USFWS
	Town:	Brownville, Rodman, Pamelia, Orleans, Ellisburg, Adams, Hounsfield, Watertown, Clayton			
	Location:	Documented beyond the boundaries of the project site. For information on the population at this location and management considerations, please contact the NYS DEC Regional Wildlife Manager for the Region where the project is located, or the NYS DEC Endangered Species Unit at 518-402-8859.			

					Office Use
Myotis sodalis **Indiana Bat**	**NY Legal Status:**	Endangered	**NYS Rank:**	S1 - Critically imperiled	12378
	Federal Listing:	Endangered	**Global Rank:**	G2 - Imperiled	ESU
	County:	Jefferson			USFWS
	Town:	Le Ray			
	Location:	Documented beyond the boundaries of the project site. For information on the population at this location and management considerations, please contact the NYS DEC Regional Wildlife Manager for the Region where the project is located, or the NYS DEC Endangered Species Unit at 518-402-8859.			

OTHER

					Office Use
Bat Colony	**NY Legal Status:**	Unprotected	**NYS Rank:**	SNR - Rank not assigned	6103
	Federal Listing:		**Global Rank:**	GNR - Not ranked	
	County:	Jefferson			
	Town:	Watertown			S
	Location:	Documented beyond the boundaries of the project site. For information on the population at this location and management considerations, please contact the NYS DEC Regional Wildlife Manager for the Region where the project is located, or the NYS DEC Endangered Species Unit at 518-402-8859.			

					Office Use
Bat Colony	**NY Legal Status:**	Unprotected	**NYS Rank:**	SNR - Rank not assigned	6438
	Federal Listing:		**Global Rank:**	GNR - Not ranked	
	County:	St. Lawrence			
	Town:	Rossie			S
	Location:	Documented beyond the boundaries of the project site. For information on the population at this location and management considerations, please contact the NYS DEC Regional Wildlife Manager for the Region where the project is located, or the NYS DEC Endangered Species Unit at 518-402-8859.			

9 Records Processed

These bat occurrences are within 40 miles of the project site.

April 19, 2007

Page 2 of 2

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Natural Heritage Report on Rare Species and Ecological Communities

BIRDS

Dendroica castanea

					Office Use
Bay-breasted Warbler	**NY Legal Status:**	Protected	**NYS Rank:**	S2 - Imperiled	2157
	Federal Listing:		**Global Rank:**	G5 - Demonstrably secure	
	Last Report:	1985-07-19	**EO Rank:**	Extant	
	County:	Lewis			M
	Town:	West Turin			
	Location:	High Market			
	General Quality and Habitat:	Natural spruce-fir stand.			

Picoides dorsalis

					Office Use
Three-toed Woodpecker	**NY Legal Status:**	Protected	**NYS Rank:**	S2 - Imperiled	6423
	Federal Listing:		**Global Rank:**	G5 - Demonstrably secure	
	Last Report:	1999-09-10	**EO Rank:**	Extant	
	County:	Lewis			
	Town:	Montague			
	Location:	Mad River Swamp			
	General Quality and Habitat:				

Spizella pallida

					Office Use
Clay-colored Sparrow	**NY Legal Status:**	Protected	**NYS Rank:**	S2 - Imperiled	359
	Federal Listing:		**Global Rank:**	G5 - Demonstrably secure	
	Last Report:	1985-07-05	**EO Rank:**	Extant	
	County:	Lewis			M
	Town:	Martinsburg			
	Location:	Flat Rock Road			
	General Quality and Habitat:	An old field with scattered young apple trees, hawthorns and white pine, most no more than 15 feet tall. The ground cover is mostly grasses.			

3 Records Processed

These bird occurrences are within 10 miles of the project site.

April 19, 2007

Page 1 of 1

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Natural Heritage Report on Rare Species and Ecological Communities

COMMUNITIES

Shallow emergent marsh

This occurrence of Shallow Emergent Marsh is considered significant from a statewide perspective by the NY Natural Heritage Program. It is either an occurrence of a community type that is rare in the state or a high quality example of a more common community type. By meeting specific, documented significance criteria, the NY Natural Heritage Program considers this occurrence to have high ecological and conservation value. Office Use

NY Legal Status:	Unprotected	**NYS Rank:**	S5	704
Federal Listing:		**Global Rank:**	G5	
Last Report:	1997-08-28	**EO Rank:**		
County:	Lewis			S
Town:	Martinsburg, Montague, West Turin			
Location:	East Branch Fish Creek			
Directions:	There are two access points to this community: 1) from Tabolt's Corners, go west on the old railroad bed. This is a gated road requiring a key and permission. The east branch of Fish Creek crosses about 7.85 mi west of the gate, 2) from Route 26 at Martinsburg, go west on Keener Hill Road to Graves Road and then to French Road. Go as far down the French Road "extension" as possible (about 1.25 mi), then walk west to the community, about 0.8-1.0 mi.			
General Quality and Habitat:	A very large, undisturbed community in intact landscape with selective logging. This natural community occurs in the center of the Tug Hill Plateau. The site includes a creek with a sandy to rocky bottom running through generally northern successional hardwoods. The borders of the creek widen in places to sedge meadow/shrub swamp/shallow emergent marsh. This is a remote area with sparse and well hidden camps in a largely logged landscape.			

Shrub swamp

This occurrence of Shrub Swamp is considered significant from a statewide perspective by the NY Natural Heritage Program. It is either an occurrence of a community type that is rare in the state or a high quality example of a more common community type. By meeting specific, documented significance criteria, the NY Natural Heritage Program considers this occurrence to have high ecological and conservation value. Office Use

NY Legal Status:	Unprotected	**NYS Rank:**	S5	752
Federal Listing:		**Global Rank:**	G5	
Last Report:	1999-07-22	**EO Rank:**		
County:	Lewis			
Town:	Martinsburg, Montague, Osceola, West Turin			
Location:	East Branch Fish Creek			
Directions:	From Tabolt's Corners, go west on an old railroad bed. This is a gated road requiring a key and permission. The east branch of Fish Creek crosses at about 7.85 mi west of the gate. An additional access point is from French Road west of Martinsburg. Go as far down (west) the French Road "extension" as possible (about 1.25 mi), then walk west to the swamp (about 0.8-1.0 mi).			
General Quality and Habitat:	The swamp is an outstanding wetland complex within a stream corridor that has escaped logging. The community is large, undisturbed, and diverse in an intact landscape with selective logging. Stream dynamics are excellent with many intact mega fauna popul This natural community occurs in the center of the Tug Hill Plateau. The site includes a creek with a sandy to rocky bottom running through generally northern successional hardwoods. The borders of the creek widen in places to sedge meadow/shrub swamp/shallow emergent marsh. This is a remote area with sparse and well hidden camps in a largely logged landscape.			

These occurrences are within the project site or in close proximity.

April 19, 2007 Page 1 of

Natural Heritage Report on Rare Species and Ecological Communities

Marsh headwater stream

This occurrence of Marsh Headwater Stream is considered significant from a statewide perspective by the NY Natural Heritage Program. It is either an occurrence of a community type that is rare in the state or a high quality example of a more common community type. By meeting specific, documented significance criteria, the NY Natural Heritage Program considers this occurrence to have high ecological and conservation value. Office Use

NY Legal Status:	Unprotected	**NYS Rank:**	S4	1101
Federal Listing:		**Global Rank:**	G4	
Last Report:	2001-09-17	**EO Rank:**		
County:	Lewis			
Town:	Martinsburg, West Turin			
Location:	East Branch Fish Creek			
Directions:	This stream occurs along the upper portions of East Branch Fish Creek and its associated tributaries (Sixmile Creek, Sevenmile Creek, and Deep Creek). From Tabolt Corners, go west on the old railroad bed. This is a gated road requiring a key and permission to access. The East Branch Fish Creek crosses approximately 7.85 mi west of the gate. The creek is accessible from logging roads on timber company land with owner permission.			
General Quality and Habitat:	This is a moderately large network of stream segments with few localized disturbances, very good habitat and species diversity. It occurs in a large natural landscape with intact forest buffer and somewhat intensively logged distant terraces and with onl This occurrence consists of the marshy portions of a large, low gradient stream complex in the center of the Tug Hill Plateau. The streambanks are natural, primarily short and of anaerobic silt in upper reaches (and often bordering pools), taller and rockier in the lower reaches (often bordering runs). The stream is primarily bordered by shallow emergent marsh, which in turn is usually fringed by alder-dominated shrub swamp in wide to linear wetlands.			

Beech-maple mesic forest

This occurrence of Beech-Maple Mesic Forest is considered significant from a statewide perspective by the NY Natural Heritage Program. It is either an occurrence of a community type that is rare in the state or a high quality example of a more common community type. By meeting specific, documented significance criteria, the NY Natural Heritage Program considers this occurrence to have high ecological and conservation value. Office Use

NY Legal Status:	Unprotected	**NYS Rank:**	S4	859
Federal Listing:		**Global Rank:**	G4	
Last Report:	2001-05-30	**EO Rank:**		
County:	Lewis, Oswego, Jefferson			
Town:	Martinsburg, Montague, Osceola, West Turin, Redfield, Worth			
Location:	Central Tug Hill Forest			
Directions:	The community is the entire central core of the Tug Hill. Perimeter roads include Route 26 to the east, Route 177 to the north, Route 17 to the west, and Route 46 to the south.			
General Quality and Habitat:	This is a very large example of primarily second and third growth with a few scattered small patches of relatively mature forest, forming a substantial part of a very large forest matrix landscape with little or no paved or publicly accessible roads, but This is the predominant forest type within a large relatively remote area representing approximately 121,000 acres of forest matrix on the central part of the Tug Hill Plateau. Beech-maple mesic forest co-occurs in the upland forest matrix with successional northern hardwoods and embedded small patches of spruce-northern hardwood forest that have recovered from past logging, spruce flats surrounding wetlands, and brushy cleared land in recently logged areas.			

4 Records Processed

These occurrences are within the project site or in close proximity.

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Natural Heritage Report on Rare Species and Ecological Communities

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Natural Heritage Report on Rare Species and Ecological Communities

COMMUNITIES

Rocky headwater stream

This occurrence of Rocky Headwater Stream is considered significant from a statewide perspective by the NY Natural Heritage Program. It is either an occurrence of a community type that is rare in the state or a high quality example of a more common community type. By meeting specific, documented significance criteria, the NY Natural Heritage Program considers this occurrence to have high ecological and conservation value.

Office Use

NY Legal Status:	Unprotected	**NYS Rank:**	S4	203(
Federal Listing:		**Global Rank:**	G4	
Last Report:	2001-09-18	**EO Rank:**		
County:	Lewis			S
Town:	Osceola, West Turin, Montague, Martinsburg			
Location:	East Branch Fish Creek			

Directions: This stream occurs along the upper portions of East Branch Fish Creek and its associated tributaries (Sixmile Creek, Sevenmile Creek, and Deep Creek). From Tabolt Corners, go west on the old railroad bed. This is a gated road requiring a key and permission to access. The East Branch Fish Creek crosses approximately 7.85 mi west of the gate. The creek is accessible from logging roads on timber company land with owner permission.

General Quality and Habitat: This moderately large network of stream reaches has a few localized disturbances, a low gradient, and good species diversity. It is located in a large, natural landscape with an intact forest buffer and somewhat intensively logged upper slopes of the watershed and with only few minor road crossings. This occurrence describes the rocky portion of a low gradient, large headwater stream complex in the center of the Tug Hill Plateau. Associated riverside communities include small channel islands, often with cobble shore, and narrow strips of shallow emergent marsh and shrub swamp. Banks are natural, primarily moist upland forests with intact canopy including spruce flats on low terraces and scattered, small high terrace floodplains. The stream is buffered by a mosaic of beech-maple mesic forest and spruce-northern hardwood forest on low hills. The stream complex consists of about 75% marsh headwater stream segments interspersed with 25% rocky headwater stream segments totaling about 40 miles of stream length. Nutrient loading is primarily from upland runoff and from marshes bordering marsh headwater segments. The stream complex contains four associated major branches with numerous tributaries. Very small intermittent streams may feed into the stream. The headwater portion flows into a midreach stream below the confluence of East Branch Fish Creek and Sixmile Creek. The watershed is large and flat, totaling about 14,500 acres and primarily with historically to heavily logged forests. There are no obvious cultural displacements. Three small dirt logging roads (fords and one bridge) cross the community. Ditches and impoundments occur along associated marsh headwater stream segments bordering the largest logging road ("GW Road"). The site is centered in an area of about 121,000 acres and about 85% forested unbisected by paved and publicly accessible roads but with numerous dirt logging road intrusions.

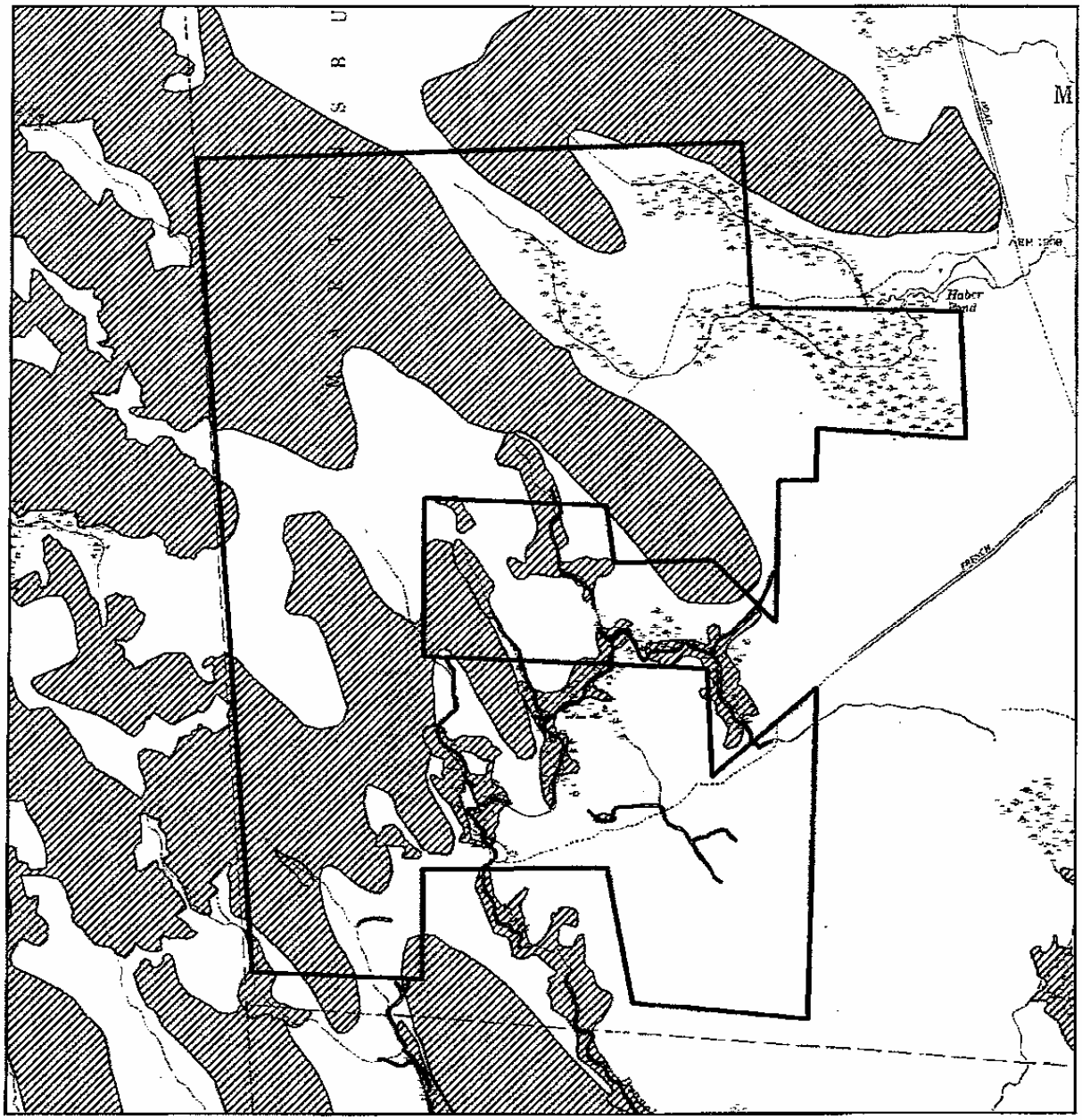
1 Record Processed

This occurrence is within the project site or in close proximity.

April 19, 2007 Page 1 of

Natural Heritage Map of Rare Species and Ecological Communities

Prepared April 19, 2007 by NY Natural Heritage Program, NYS DEC, Albany, NY



Legend

Project Site

NY Natural Heritage Program Database Records*

Community

1:30,000

0 0.2 0.4 0.8 1.2 1.6 Mile

*The locations that are displayed are considered sensitive and should not be released to the public without permission. We do not provide map locations for all records. Please see report for details.

USERS GUIDE TO NY NATURAL HERITAGE DATA

New York Natural Heritage Program, 625 Broadway, 5th Floor, Albany, NY 12233-4757 phone: (518) 402-8935

NATURAL HERITAGE PROGRAM: The NY Natural Heritage Program is a partnership between the NYS Department of Environmental Conservation (NYS DEC) and The Nature Conservancy. Our mission is to enable and enhance conservation of rare animals, rare plants, and significant communities. We accomplish this mission by combining thorough field inventories, scientific analyses, expert interpretation, and the most comprehensive database on New York's distinctive biodiversity to deliver the highest quality information for natural resource planning, protection, and management.

DATA SENSITIVITY: The data provided in the report are ecologically sensitive and should be treated in a sensitive manner. The report is for your in-house use and should **not** be released, distributed or incorporated in a public document without prior permission from the Natural Heritage Program.

EO RANK: A letter code for the quality of the occurrence of the rare species or significant natural community, based on population size or area, condition, and landscape context.

A-E = Extant: A=Excellent, B=Good, C=Fair, D=Poor, E=Extant but with insufficient data to assign a rank of A-D.
F = Failed to find. Did not locate species during a limited search, but habitat is still there and further field work is justified.
H = Historical. Historical occurrence without any recent field information.
X = Extirpated. Field/other data indicates element/habitat is destroyed and the element no longer exists at this location.
U = Extant/Historical status uncertain.
Blank = Not assigned.

LAST REPORT: The date that the rare species or significant natural community was last observed at this location, as documented in the Natural Heritage databases. The format is most often YYYY-MM-DD.

NY LEGAL STATUS – Animals:

Categories of Endangered and Threatened species are defined in New York State Environmental Conservation Law section 11-0535. Endangered, Threatened, and Special Concern species are listed in regulation 6NYCRR 182.5.

E - **Endangered Species:** any species which meet one of the following criteria:
- Any native species in imminent danger of extirpation or extinction in New York.
- Any species listed as endangered by the United States Department of the Interior, as enumerated in the Code of Federal Regulations 50 CFR 17.11.

T - **Threatened Species:** any species which meet one of the following criteria:
- Any native species likely to become an endangered species within the foreseeable future in NY.
- Any species listed as threatened by the U.S. Department of the Interior, as enumerated in the Code of the Federal Regulations 50 CFR 17.11.

SC - **Special Concern Species:** those species which are not yet recognized as endangered or threatened, but for which documented concern exists for their continued welfare in New York. Unlike the first two categories, species of special concern receive no additional legal protection under Environmental Conservation Law section 11-0535 (Endangered and Threatened Species).

P - **Protected Wildlife** (defined in Environmental Conservation Law section 11-0103): wild game, protected wild birds, and endangered species of wildlife.

U - **Unprotected** (defined in Environmental Conservation Law section 11-0103): the species may be taken at any time without limit; however a license to take may be required..

G - **Game** (defined in Environmental Conservation Law section 11-0103): any of a variety of big game or small game species as stated in the Environmental Conservation Law; many normally have an open season for at least part of the year, and are protected at other times.

NY LEGAL STATUS – Plants:

The following categories are defined in regulation 6NYCRR part 193.3 and apply to NYS Environmental Conservation Law section 9-1503.

E - **Endangered Species:** listed species are those with:
- 5 or fewer extant sites, or
- fewer than 1,000 individuals, or
- restricted to fewer than 4 U.S.G.S. 7 ½ minute topographical maps, or
- species listed as endangered by U.S. Dept. of Interior, as enumerated in Code of Federal Regulations 50 CFR 17.11.

T - **Threatened:** listed species are those with:
- 6 to fewer than 20 extant sites, or
- 1,000 to fewer than 3,000 individuals, or
- restricted to not less than 4 or more than 7 U.S.G.S. 7 and ½ minute topographical maps, or
- listed as threatened by U.S. Department of Interior, as enumerated in Code of Federal Regulations 50 CFR 17.11.

Lewis County

Federally Listed Endangered and Threatened Species and Candidate Species

This list represents the best available information regarding known or likely County occurrences of Federally-listed and candidate species and is subject to change as new information becomes available.

Common Name	Scientific Name	Status
Indiana bat (S)	*Myotis sodalis*	E

Status Codes: E=Endangered T=Threatened P=Proposed C=Candidate D=Delisted

W=Winter S=Summer

Information current as of: 9/4/2007

Appendix E. Breeding Bird Frequency on 1996-2005 Highmarket BBS Route (61076)

Taxonomic Sort[1]	birds/hr
Canada Goose	0.10
Wood Duck	0.30
Mallard	0.60
Ruffed Grouse	0.05
Wild Turkey	2.30
American Bittern (SC)	**0.05**
Great Blue Heron	0.20
Green Heron	0.10
Turkey Vulture	0.65
Northern Harrier (T)	**0.40**
Cooper's Hawk (SC)	**0.05**
Broad-winged Hawk	0.05
Red-tailed Hawk	0.05
American Kestrel	0.10
Killdeer	2.35
Spotted Sandpiper	0.10
Upland Sandpiper (T)*	**0.05**
Wilson's Snipe	0.10
American Woodcock*	0.20
Herring Gull	0.05
Rock Pigeon	1.90
Mourning Dove	2.70
Black-billed Cuckoo	0.05
Great Horned Owl	0.20
Barred Owl	0.05
Chimney Swift	0.05
Ruby-throated Hummingbird	0.35
Belted Kingfisher	0.20
Yellow-bellied Sapsucker	0.35
Hairy Woodpecker	0.40
Yellow-shafted Flicker	0.20
Pileated Woodpecker	0.20
Eastern Wood-Pewee	0.20
Alder Flycatcher	2.85
Least Flycatcher	0.35
Eastern Phoebe	0.95
Great Crested Flycatcher	0.35
Eastern Kingbird	1.45
Yellow-throated Vireo	0.05
Blue-headed Vireo	1.60
Warbling Vireo	0.25
Philadelphia Vireo	0.55
Red-eyed Vireo	8.75

Frequency Sort[1]	birds/hr
Red-winged Blackbird	15.05
American Robin	12.15
Song Sparrow	10.55
Chestnut-sided Warbler	10.40
American Goldfinch	9.05
Red-eyed Vireo	8.75
Common Yellowthroat	8.30
European Starling	7.00
Barn Swallow	6.60
Bobolink	6.50
White-throated Sparrow	6.00
Tree Swallow	5.30
Ovenbird	4.85
Wood Thrush*	4.50
Savannah Sparrow	4.50
American Crow	3.85
Alder Flycatcher	2.85
Common Grackle	2.85
Cedar Waxwing	2.75
Mourning Dove	2.70
Veery	2.70
Black-throated Green Warbler	2.65
Chipping Sparrow	2.45
Killdeer	2.35
Wild Turkey	2.30
Purple Finch	2.20
Eastern Meadowlark	2.05
Rock Pigeon	1.90
Yellow Warbler	1.90
American Redstart	1.80
Winter Wren	1.70
Black-throated Blue Warbler	1.65
Blue-headed Vireo	1.60
House Sparrow	1.60
Swamp Sparrow	1.55
Canada Warbler*	1.50
Eastern Kingbird	1.45
Gray Catbird	1.35
House Wren	1.25
Blue Jay	1.20
Horned Lark (SC)	**1.20**
Nashville Warbler	1.15
Mourning Warbler	1.05

Blue Jay	1.20
American Crow	3.85
Common Raven	0.25
Horned Lark (SC)	**1.20**
Tree Swallow	5.30
Northern Rough-winged Swallow	0.25
Bank Swallow	0.30
Barn Swallow	6.60
Black-capped Chickadee	0.90
Red-breasted Nuthatch	0.50
White-breasted Nuthatch	0.20
House Wren	1.25
Winter Wren	1.70
Eastern Bluebird	0.05
Veery	2.70
Gray-cheeked Thrush (Bicknell's*?, SC)	**0.05**
Swainson's Thrush	0.85
Hermit Thrush	0.75
Wood Thrush*	4.50
American Robin	12.15
Gray Catbird	1.35
Northern Mockingbird	0.05
Brown Thrasher	0.50
European Starling	7.00
Cedar Waxwing	2.75
Tennessee Warbler	0.05
Nashville Warbler	1.15
Northern Parula	0.05
Yellow Warbler	1.90
Chestnut-sided Warbler	10.40
Magnolia Warbler	0.85
Black-throated Blue Warbler	1.65
Myrtle Warbler	0.60
Black-throated Green Warbler	2.65
Blackburnian Warbler	0.60
Pine Warbler	0.10
Cerulean Warbler (SC)*	**0.10**
Black-and-white Warbler	0.50
American Redstart	1.80
Worm-eating Warbler*	0.10
Ovenbird	4.85
Northern Waterthrush	0.30
Louisiana Waterthrush	0.20
Mourning Warbler	1.05
Common Yellowthroat	8.30
Wilson's Warbler	0.05
Canada Warbler*	1.50

Eastern Phoebe	0.95
Black-capped Chickadee	0.90
Swainson's Thrush	0.85
Magnolia Warbler	0.85
Hermit Thrush	0.75
Indigo Bunting	0.75
Rose-breasted Grosbeak	0.70
Turkey Vulture	0.65
Mallard	0.60
Myrtle Warbler	0.60
Blackburnian Warbler	0.60
Philadelphia Vireo	0.55
Red-breasted Nuthatch	0.50
Brown Thrasher	0.50
Black-and-white Warbler	0.50
Slate-colored Junco	0.45
Northern Harrier (T)	**0.40**
Hairy Woodpecker	0.40
Brown-headed Cowbird	0.40
Ruby-throated Hummingbird	0.35
Yellow-bellied Sapsucker	0.35
Least Flycatcher	0.35
Great Crested Flycatcher	0.35
Eastern Towhee	0.35
Wood Duck	0.30
Bank Swallow	0.30
Northern Waterthrush	0.30
Warbling Vireo	0.25
Common Raven	0.25
Northern Rough-winged Swallow	0.25
Northern Cardinal	0.25
Great Blue Heron	0.20
American Woodcock	0.20
Great Horned Owl	0.20
Belted Kingfisher	0.20
Yellow-shafted Flicker	0.20
Pileated Woodpecker	0.20
Eastern Wood-Pewee	0.20
White-breasted Nuthatch	0.20
Louisiana Waterthrush	0.20
Field Sparrow	0.15
Baltimore Oriole	0.15
White-winged Crossbill	0.15
Canada Goose	0.10
Green Heron	0.10
American Kestrel	0.10
Spotted Sandpiper	0.10

Scarlet Tanager	0.10
Eastern Towhee	0.35
Chipping Sparrow	2.45
Field Sparrow	0.15
Savannah Sparrow	4.50
Song Sparrow	10.55
Swamp Sparrow	1.55
White-throated Sparrow	6.00
Slate-colored Junco	0.45
Northern Cardinal	0.25
Rose-breasted Grosbeak	0.70
Indigo Bunting	0.75
Bobolink	6.50
Red-winged Blackbird	15.05
Eastern Meadowlark	2.05
Common Grackle	2.85
Brown-headed Cowbird	0.40
Baltimore Oriole	0.15
Purple Finch	2.20
White-winged Crossbill	0.15
Pine Siskin	0.05
American Goldfinch	9.05
House Sparrow	1.60
# Species	**113**

Wilson's Snipe	0.10
Pine Warbler	0.10
Cerulean Warbler (SC)*	**0.10**
Worm-eating Warbler*	0.10
Scarlet Tanager	0.10
Ruffed Grouse	0.05
American Bittern (SC)	**0.05**
Cooper's Hawk (SC)	**0.05**
Broad-winged Hawk	0.05
Red-tailed Hawk	0.05
Upland Sandpiper (T)*	**0.05**
Herring Gull	0.05
Black-billed Cuckoo	0.05
Barred Owl	0.05
Chimney Swift	0.05
Yellow-throated Vireo	0.05
Eastern Bluebird	0.05
Gray-cheeked Thrush (Bicknell's?*, SC)	**0.05**
Northern Mockingbird	0.05
Tennessee Warbler	0.05
Northern Parula	0.05
Wilson's Warbler	0.05
Pine Siskin	0.05
Cumulative Frequency	**194.65**

[1] Listed species are bold-faced; see Table 4.1-1. * = ABC Green List (see discussion in Section 4.1).

Appendix F. Wintering Bird Frequency on the 1997-2006 New Boston CBC (NYNB)

Taxonomic Sort[1]	birds/hr
Canada Goose	0.95
American Black Duck*	0.01
Mallard	0.06
Common Merganser	0.01
Ring-necked Pheasant	0.01
Ruffed Grouse	0.16
Wild Turkey	2.58
Bald Eagle (T, US-Delisted)	**0.01**
Northern Harrier (T)	**0.00**
Sharp-shinned Hawk (SC)	**0.01**
Cooper's Hawk (SC)	**0.02**
Northern Goshawk (SC)	**0.03**
Red-tailed Hawk	0.13
Rough-legged Hawk	0.14
Ring-billed Gull	0.01
Herring Gull	0.06
Glaucous Gull	0.00
Great Black-backed Gull	0.03
Rock Pigeon	3.83
Mourning Dove	0.73
Great Horned Owl	0.03
Snowy Owl	0.01
Barred Owl	0.02
Northern Saw-whet Owl	0.00
Downy Woodpecker	0.30
Hairy Woodpecker	0.25
Pileated Woodpecker	0.03
Northern Shrike	0.10
Blue Jay	5.19
American Crow	2.53
Common Raven	0.15
Horned Lark (SC)	**0.16**
Black-capped Chickadee	8.83
Red-breasted Nuthatch	0.40
White-breasted Nuthatch	0.23
Brown Creeper	0.04
Golden-crowned Kinglet	0.19
American Robin	0.08
European Starling	9.56
Bohemian Waxwing	0.01
Cedar Waxwing	0.90
American Tree Sparrow	0.94
White-throated Sparrow	0.02

Frequency Sort[1]	birds/hr
European Starling	9.56
Black-capped Chickadee	8.83
Blue Jay	5.19
Rock Pigeon	3.83
House Sparrow	3.27
Wild Turkey	2.58
American Crow	2.53
Common Redpoll	2.04
Snow Bunting	1.92
Evening Grosbeak	1.00
Canada Goose	0.95
American Tree Sparrow	0.94
Cedar Waxwing	0.90
Mourning Dove	0.73
Red-breasted Nuthatch	0.40
Downy Woodpecker	0.30
Pine Grosbeak	0.30
House Finch	0.26
Hairy Woodpecker	0.25
White-breasted Nuthatch	0.23
American Goldfinch	0.20
Golden-crowned Kinglet	0.19
Dark-eyed Junco	0.19
Ruffed Grouse	0.16
Horned Lark (SC)	**0.16**
Common Raven	0.15
Brown-headed Cowbird	0.15
Rough-legged Hawk	0.14
Red-tailed Hawk	0.13
Northern Shrike	0.10
Purple Finch	0.10
American Robin	0.08
Mallard	0.06
Herring Gull	0.06
Brown Creeper	0.04
Northern Goshawk (SC)	**0.03**
Great Black-backed Gull	0.03
Great Horned Owl	0.03
Pileated Woodpecker	0.03
Cooper's Hawk (SC)	**0.02**
Barred Owl	0.02
White-throated Sparrow	0.02
White-winged Crossbill	0.02

Dark-eyed Junco	0.19
Snow Bunting	1.92
Northern Cardinal	0.01
Brown-headed Cowbird	0.15
Pine Grosbeak	0.30
Purple Finch	0.10
House Finch	0.26
Red Crossbill	0.01
White-winged Crossbill	0.02
Common Redpoll	2.04
Pine Siskin	0.02
American Goldfinch	0.20
Evening Grosbeak	1.00
House Sparrow	3.27
# Species	**57**

Pine Siskin	0.02
American Black Duck*	0.01
Common Merganser	0.01
Ring-necked Pheasant	0.01
Bald Eagle (T, US-Delisted)	**0.01**
Sharp-shinned Hawk (SC)	**0.01**
Ring-billed Gull	0.01
Snowy Owl	0.01
Bohemian Waxwing	0.01
Northern Cardinal	0.01
Red Crossbill	0.01
Northern Harrier (T)	**0.00**
Glaucous Gull	0.00
Northern Saw-whet Owl	0.00
Cumulative Frequency	**48.24**

[1] Listed species are bold-faced; see Table 4.1-1. * = ABC Green List (see discussion in Section 4.1).

Appendix G. Annotated Review of Avian Fatality Studies in North America

The numbers of fatalities provided are, in most cases, recorded fatalities. Estimates of fatalities per turbine per year include searcher efficiency and carcass removal rates, thereby accounting for carcasses missed by searchers and carcasses removed by scavengers. Modern turbines ranged between about 58.5 m (192 feet) and about 122 m (400 feet) in height. Older turbines were less than 50 m (164 feet) in height. None of the turbines in the studies had guy wires.

Midwest - Farmland

- **Kansas** – St. Mary's, 2 modern turbines in grassland prairie adjacent to a coal-fired plant, 2 migration seasons; 33 surveys, 0 fatalities; Young 1999

- **Minnesota** – Buffalo Ridge near Lake Benton, 200+ modern turbines (some older turbines) in farm and grassland, four years of study (1996-1999), 53 fatalities, 2-4 fatalities per turbine per year (mostly songbirds and one Red-tailed Hawk); Johnson et al. 2002

- **Illinois –** Crescent Ridge, 33 modern turbines in farmland, fall and spring migration, 10 fatalities, ~1 fatality per turbine per year; 1,363 turbine searches, mostly night migrants, 1 Red-tailed Hawk; Kerlinger et al. 2007

- **Iowa** – Algona, 3 modern turbines in farmland, 3 migration seasons, zero fatalities; Demastes and Trainer 2000

- **Iowa** – Top of Iowa, 89 modern turbines (26 studied) in tilled farmland, 2 years of study, 7 fatalities, approx. 1 fatality per turbine per year, mostly songbirds, 2 Red-tailed Hawks, no shorebirds or waterfowl; Jain 2005, Koford et al. 2005

- **Wisconsin** – Kewaunee County Peninsula, 31 modern turbines in farmland, 2 years of study (four migration seasons), 25 fatalities, 1.3 fatalities per turbine per year, three waterfowl, 14 songbirds (including some night migrants), no raptors; Howe et al. 2002

- **Wisconsin** – Shirley, 2 modern turbines in farmland, 54 surveys, 1 year study (spring and fall migration seasons), 1 fatality (a night migrating songbird), no raptors or waterbirds; Howe and Atwater 1999

Eastern States – Farmland and Forest

- **New York** - Tug Hill Plateau, 2 older turbines in farmland, 2 migration seasons, zero fatalities; Cooper et al. 1995

- **New York –** Maple Ridge Wind Farm (Tug Hill Plateau), 120 modern turbines in farmland adjacent to fragmented forest, June-November (2,244 turbine searches), ~2-9 fatalities per turbine, 80% songbirds, 1 American Kestrel, few waterfowl; Jain et al. 2007

- **New York** – Madison, 7 modern turbines in farmland, 1 year study, 4 fatalities, 2 migrant songbirds, 1 owl, and 1 woodpecker, no diurnal raptors or waterbirds; Kerlinger 2002

- **Pennsylvania** – Garrett (Somerset County), 8 modern turbines in farm fields, 1 year study, 0 fatalities; Kerlinger 2001

- **Pennsylvania** – Meyersdale (Somerset County), 20 modern turbines on a forested ridgetop, more than 20 searches of all turbines from July 30 to September 13, 2004; 13 avian carcasses found of 6 known species – mostly migrant songbirds, no raptors or waterbirds; Arnett et al. 2005

- **West Virginia** – Mountaineer Wind Energy Center, 44 modern turbines on forested ridge, one-year study in 2003 (22 searches of all turbines), 69 fatalities found, ~200-plus total fatalities when corrected for searcher efficiency and scavenging (4+ fatalities per turbine per year; ~3 night migrating songbirds per turbine per year, two Turkey Vultures and one Red-tailed Hawk); Kerns and Kerlinger 2004. In 2004, more than 20 searches from July 31 to September 11 found 15 avian carcasses of 10 known species (Arnett et al. 2005).

- **Vermont** – Searsburg near Green Mountain National Forest, 11 modern turbines on forested mountain top, studied during nesting and fall migration seasons, 0 fatalities; Kerlinger 2002

- **Massachusetts** - Hull, 1 modern turbine, open grassy fields adjacent to school and ferry terminal on island in Boston Harbor, informal searches for at least 1 year on dozens of occasions have revealed no fatalities; Malcolm Brown, personal communication, 2002

- **Tennessee** – Buffalo Mountain, 3 modern turbines on forested/strip-mined mountain, three years, approximately 7 fatalities per turbine per year (night migrating song and other birds); Nicholson 2001, 2002, and personal communication

Canada

- **Ontario** – Pickering Wind Turbine, 1 modern turbine near a marsh, 2 migration seasons, 2 fatalities (night migrating songbirds), probably about 4-5 fatalities per turbine per year; James, unpublished report

- **Ontario** – Exhibition Place, 1 modern turbine in Toronto on lakefront, 2 migration seasons, 2 fatalities, European Starling and American Robin; mortality projected at 3 fatalities per turbine per year; James and Coady 2003

- **Ontario** – Erie Shores Wind Farm, 66 modern turbines in farmland with woodlots, one migration season, 32 carcasses, 78% of which were small passerines with most nocturnal migrants, one Turkey Vulture and one Sharp-shinned Hawk, one Virginia Rail;, 2006 mortality estimated at 4.38 birds/turbine; Ross D. James, personal communication

Western States – Prairie and Farmland

- **Wyoming** – Foote Creek Rim, 69 modern turbines in prairie/rangeland, two years of study, 75 fatalities, songbirds, 48% night migrants, 4 raptors), 1.8 fatalities per turbine per year, 15 additional fatalities were at guyed meteorology towers; Young et al. 2003

- **Colorado** – Ponnequin, 29 (44 in 2001) modern turbines in rangeland, five years of study - 1999-2003, approx. two dozen birds per year, one duck, one American Kestrel fatality; Curry & Kerlinger unpublished data

- **Washington** – Nine Canyons, 37 modern turbines, prairie and farmland, one year, 36 fatalities, mostly songbirds, one kestrel, one Short-eared Owl, no diurnal raptors, 3.6 fatalities per turbine per year; Erickson 2003

- **Oregon-Washington** – Stateline Project, 124 of 399 modern turbines in farmland searched, 1.5 years of study, 106 fatalities, seven raptors, 28+ bird species, few waterbirds, 1.7 fatalities per turbine per year, 1.0 night migrant fatality per turbine per year; Erickson et al. 2003

- **Oregon** – Klondike, 16 modern turbines in rangeland and shrub-steppe, one year, eight fatalities, songbirds, including 50% night migrants, plus two Canada Geese, no raptors, 1.3 fatalities per turbine per year; Johnson et al. 2003

- **Oregon** – Vansycle, 38 modern turbines in farm and rangeland, one year, 11 fatalities, seven songbirds, including about four night migrants, and four gamebirds (no raptors or waterbirds); Erickson et al. 2000

- **California** - Altamont Pass Wind Resource Area (APWRA), 5,400 older turbines mostly on lattice towers in grazing and tilled land, many years, large numbers of raptor fatalities (>400 reported) and some other birds; Howell and DiDonato,1991, Howell 1997, Orloff and Flannery 1992, 1996, Kerlinger and Curry 1997, Thelander and Rugge 2000

- **California** – Montezuma Hills, 237 older turbines, 11 modern turbines in tilled farmland, two-plus years of study, 30-plus fatalities found (including 10 raptors, two songbirds, one duck); Howell 1997

- **California** - High Winds, 90 modern turbines in tilled farmland, two year study, 4,220 turbine searches, 163 (183 including incidental finds) fatalities found, 7 raptor species, one-third songbirds, few waterbirds, 2.0-2.9 fatalities per turbine per year; Kerlinger et al. 2006

- **California** - San Gorgonio Pass Wind Resource Area, thousands of older turbines, 120 studied in desert, two year of study, 30 fatalities, nine waterfowl, two raptors, four songbirds, <1 fatality per turbine per year; Anderson et al. 2000

- **California** - Tehachapi Pass Wind Resource Area, thousands of turbines, 100's of mostly older turbines studied, in Mojave Desert mountains (grazing land and scrub), two-plus years

of study, 84 fatalities (raptors, mostly songbirds, few waterbirds); Orloff 1992, Anderson et al. 2000