AVIAN RISK ASSESSMENT

Marble River Wind Project

Clinton County, New York

Report Prepared for:

Marble River, LLC

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Executive Summary

This report details the results of an Avian Risk Assessment for the proposed Marble River Wind Project (hereafter the "Project"), located in northern New York State, along the border with Canada in northwest Clinton County. AES and Horizon Wind Energy, the Project proponents, have identified two adjacent areas in the towns of Clinton and Ellenburg to develop their wind energy project. They propose 109 wind turbines, each with a nameplate capacity of 2.0 MW (total project capacity of 218 MW). Tower heights would be 78 m (256 feet) with a rotor length of 44 m (144 feet). Maximum height of the rotor tip when the rotor is in the 12 o'clock position would be 125 m (410 feet) above ground level (AGL). In the 6 o'clock position, the rotor tip could be as low as 37 m (121 feet) AGL. Turbines would be mounted on steel tubular 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 80 m (262 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 would be constructed somewhere on the Project site. The connection between the substation and existing transmission lines could be above ground.

This assessment includes and relies on: 1) a site visit conducted on October 31-November 1, 2005; 2) a review of the literature and available databases; 3) site-specific studies on breeding birds, raptor migration, and nocturnal migration; and 4) written consultations with the U.S. Fish and Wildlife Service (USFWS) and the New York State Department of Environmental Conservation (NYSDEC).

The site visit evaluated the various habitats at the site to determine the type and relative abundance of birds likely to nest, forage, rest, or otherwise use the site. The literature and database review examined the avifauna most likely to be present at or surrounding the site and information relevant to potential impacts to birds from comparable wind power facilities. The site-specific studies quantified the relative abundance and frequency of breeding birds in field and woodland habitats, altitude and volume of nocturnal migration above the site, and altitude and volume of the fall hawk migration at the site. The written consultations with wildlife agencies sought to clarify bird species of concern and listed species in the Project vicinity and other avian issues. Together, this information strongly indicates the type and approximate numbers of birds that are known or suspected to use the Project site. When incorporated into the risk assessment, this information helps determine the degree of risk to birds from the proposed wind-power development.

Regarding topography, the land at the Project site gently rises in a north to south direction from the border with Canada up toward the boundary with the Adirondack Park. The land also

drops off to the east toward Lake Champlain. Elevations range from 900 to 1,740 feet (275 to 530 m). To the south of the Project site, in Adirondack Park, the topography becomes mountainous. It is interesting to note that the Project site is on the divide between two major water drainages. Streams originating on the west side of the Project site flow northwest toward the St. Lawrence River. Those on the east side flow east toward Lake Champlain. There is a high representation of wetlands (swamp, marsh, and bog) where forest cover predominates at the Project site, such as in the Clinton section.

Regarding physiography, the Project site is located at the junction of three ecozones: Champlain Transition, St. Lawrence Plains (Malone Plain subzone), and Western Adirondack Transition (Andrle and Carroll 1988, Levine 1998). Therefore, the physiography of the Project site would be a mixture of each, with one blending into another and with some areas showing a purer expression of one ecozone than another. Based on the map presented in Levine, the Champlain Transition appears dominant. This ecozone is described as having gentle topography combined with good soil productivity. Forests consist mainly of aspen, birch, and northern hardwoods with some white pine, red spruce, and balsam fir. Nonetheless, the low swampy areas of the Project site, particularly in portions of the Clinton section, are more characteristic of the St. Lawrence Plains, where soils are of medium productivity, and land abandonment has resulted in considerable shrubland. The Western Adirondack Transition is an area of poor soils and rougher topography, where old fields, successional forests, and farms occur. It would occur at the Project site's upper elevations.

In the topographic maps, three major habitats appear: agricultural fields, woodlands, and wetlands. Woodland cover varies significantly between Project sections. The highest representation of woodland (~60%) is in the Clinton section, where swampland and bogs (the principal wetland habitats) historically limited agricultural uses. There, most wind turbines would be erected in upland woods out of the swampy low areas. At the other end of the spectrum (~15% woodland cover), Ellenburg is mainly open fields, where likely all of its wind turbines will be erected. Turbine placements may be biased toward open areas, but a significant number will no doubt be placed in woodlands.

Based on the site visit and analysis of the results of the 2000-2005 Breeding Bird Atlas (BBA), recent nearby Breeding Bird Surveys (BBS), and the site-specific Breeding Bird Field Survey (BBFS), the Project site has a diverse breeding bird community made up of mainly common species of field and woodland habitats. The commonest field species are Song Sparrow, Red-winged Blackbird, American Robin, and Bobolink, and the commonest woodland species are White-throated Sparrow, Black-capped Chickadee, Black-and-white Warbler, Veery, and Yellow Warbler (Woodlot 2005).

Waterbird diversity is fairly low, with the common breeders appearing to be Canada Goose, Wood Duck, Mallard, and Wilson's Snipe. American Kestrel appears to be the most common breeding raptor, but other likely breeding raptors include Osprey (special concern), Northern Harrier (threatened), Sharp-shinned Hawk (special concern), Cooper's Hawk (special concern), Broad-winged Hawk, and Red-tailed Hawk. Among the grassland specialists, Bobolink and Savannah Sparrow are the most commonly occurring breeders, but Northern Harrier (NYS threatened), Horned Lark (NYS special concern), Vesper Sparrow (NYS special

concern), Grasshopper Sparrow (NYS special concern), and Eastern Meadowlark also occur. No federally listed species are likely to nest within the Project boundary.

Regarding New York State listed species, the BBA recorded the endangered Peregrine Falcon twice, but nesting habitat for this species is not found in the vicinity of the Project site. The threatened Pied-billed Grebe may breed at low density in the larger marshes and ponds of the Clinton section. The threatened Northern Harrier was well recorded in the BBA, with probable records in the southern part of the Main section (part of Clinton section, Figure 3). It was also recorded in the BBFS. The threatened Upland Sandpiper was recorded in adjacent Canada, but data appear to indicate that this species does not occur as a breeder at the Project site. The threatened Sedge Wren was not recorded in any of the surveys, but the site visit found suitable habitat for this species. Breeding by the endangered Short-eared Owl and Loggerhead Shrike and by the threatened Henslow's Sparrow appears unlikely.

Among the special-concern species, it appears that the American Bittern, Osprey, Sharp-shinned Hawk, Cooper's Hawk, Horned Lark, Vesper Sparrow, and Grasshopper Sparrow breed at the Project site in small numbers. Records for Red-shouldered Hawk, Common Nighthawk, and Whip-poor-will were fewer or less conclusive, lending uncertainty to their breeding at the Project site. None of the surveys recorded Golden-winged Warbler, but some of the shrubland habitat looked suitable in the Clinton section. Habitat at the Project site does not look right for the Cerulean Warbler, but the BBFS claims to have recorded it. Northern Goshawk could also occur.

A fall marine-surveillance radar study of nocturnal migration (Woodlot 2005) demonstrated a limited avian risk. The fall passage rate averaged 152 targets/km/hour, whereas the spring rate was 254 targets/km/hour. The mean migration altitude during both seasons was well above 400 m (1,300 feet), with a fall average of 438 m and a spring average of 422 m above ground level. During fall, 5% of targets were tracked below 120 m (400 feet), whereas in spring 11% were below this level. Migratory behavior was consistent with broad-front movement with a mean direction in fall toward 193° ± 89° and in spring toward 40°±66°. Migratory songbirds likely stopover in during the day to feed and rest in woodland habitat at the site, but concentrations of these species would be no different than other woodland sites in northern New York. There was no indication of any funneling or concentrating of birds by topography and the behavior and quantity of night migrants was similar to other sites in the northeastern United States.

A 60-hour study of fall hawk migration above the Project site on 10 days between September 6 and November 2, 2005, recorded 217 raptors of 15 species. Approximately 69% of the raptors were observed flying less than 120 m (400 feet) above the ground. The overall passage rate was 3.6 birds/hour and daily counts ranged from 6 to 76 birds. This passage rate was deemed low when compared with other regional sites during the same time frame, and did not indicate a migration corridor or concentration area for these birds.

Regarding migratory waterbirds, the nearest important waterfowl stopover sites (St. Lawrence River and Lake Champlain) are located 20 miles (32 km) away. The wetlands present at the Project site are unlikely to attract migratory waterfowl in large numbers, although they will

attract smaller numbers of a variety of species. While flocks of Canada and Snow Geese are likely to visit the Project site on occasion to feed on waste grain, use of the Project site by migratory waterbirds should be fairly minimal. Otherwise, waterbirds will migrate at high altitude above the wind farm, mainly at night.

The habitat at the Project site does not suggest large concentrations of wintering birds or the presence of federally listed species during that season. Horned Lark and Snow Bunting would be the likeliest open-country birds encountered around the wind turbine placements, but their frequencies are likely to be under 10 birds per hour in optimal conditions. Northern Harrier and Short-eared Owl may forage at the Project site in winter, but it is likely that they would do so at low densities and frequencies. The federally threatened Bald Eagle winters regularly along the St. Lawrence, but the Project site is far from any eagle wintering roosts and lacks productive open-water habitats to attract the eagle.

No Important Bird Area (IBA) overlaps the Project site, or is found nearby. IBAs and federal, state, county, and private protected areas in the Project region include habitats that are not well represented at the Project site. These include high-quality grasslands, waterbird habitats, boreal habitats, and extensive forest (such as contained by Adirondack Park). It appears that the Project site does not contain what might be considered essential bird habitat, nor is it distinguishable in character, habitat, or ornithological importance from the surrounding agricultural and wooded landscape.

This avian risk assessment makes the following recommendations:

- Electrical lines within the project site should be underground between the turbines. Any new above-ground 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 free-standing (i.e., without guy wires) to prevent the potential for avian collisions.

- Size of roads and turbine pads should be minimized in order to disturb as little habitat as possible. After construction, any natural habitat should be permitted or encouraged to regenerate as close to the turbines and roads as possible in order to minimize habitat fragmentation and disturbance/displacement impacts.

- 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 breeding bird study is recommended for spring 2006 to survey the entire Project site. It may be more valuable to locate and map specific nesting areas for threatened and

special-concern species, and use this information to modify the wind farm design so as to minimize displacement impacts on these species. Success, with respect to grassland bird communities, would require a commitment by an agency, landowner, or developer to manage fields identified as high-quality grassland bird habitat. Otherwise, these fields will succeed into woodland and be lost to grassland birds. The species to focus on would be State threatened Northern Harriers, because of the higher likelihood that it nests somewhere on site. It appears unlikely that the State threatened Upland Sandpiper presently nests at the Project site, but it should be looked for. With regard to the special-concern species, their presence would help identify the highest quality field habitats, which could be set off limits to turbine placements, provided these fields can be managed to maintain their grassland bird populations. In addition, it would be useful to measure displacement impact and habituation using an impact gradient study methodology after the wind farm is constructed.

- 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 and in the Central United States.

Given that half or more of the wind turbines will be erected in field habitats, the Project will likely displace some common grassland-nesting species. But, some threatened and special-concern species may be displaced if wind turbines are placed in or adjacent to where they nest. Among listed species, the NYS threatened Northern Harrier appears likely to nest at low density in fields or marshes at the Project site. NYS Special-concern species likely include Horned Lark, Vesper Sparrow, and Grasshopper Sparrow. Displacement impacts are not likely to be regionally or globally significant, but they could affect local nesting populations, depending upon how many turbines are located in grassland areas. It is not known if these species habituate to the presence of turbines. Recommendations are made to prevent and mitigate potential impacts.

A number of wind turbines will be erected in mainly young, second-growth woodland. As a result, some woodland and woodland-edge nesting species are likely to be displaced. These will mainly be common species. Displacement impacts on woodland-nesting birds are not likely to be regionally or globally significant, but they could affect local nesting populations. Given that woodland birds are accustomed to environments with tall structures, displacement impact would be significantly less overall than with grassland birds.

No displacement of nesting waterbirds is anticipated, because the wind turbine placements will likely be far enough away from any nesting sites. Occasional flocks of Canada and Snow Geese probably stop over at the Project site to feed on waste grain but are not likely to be significantly disturbed by the presence of turbines.

Fatality numbers and species impacted at the Marble River Wind 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. Given that approximately 109 turbines are proposed for the site, the annual cumulative mortality will likely be greater than at smaller sites. These fatalities, when

distributed among many species, are not likely to be biologically significant. Among nesting birds, the species most likely to collide with wind turbines would be those that have aerial courtship displays, including the threatened Northern Harrier and Upland Sandpiper and special-concern Common Nighthawk and Horned Lark. But, collision risk for these species should be low to negligible, because few, if any (except for the lark), nest at the Project site. 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 low because the 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.

Overall, collision risk to birds at the Marble River Wind Project is likely to be minimal. From what was learned from the site visit and literature search, as well as a documented lack of significant fatalities at other wind power facilities in the Eastern and Midwestern United States, as well as at grassland sites in the western United States, there is no indication that the Marble River Wind Project will result in biologically significant collision impacts to birds.

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Figure 1. Marble River Wind Project Location in New York.

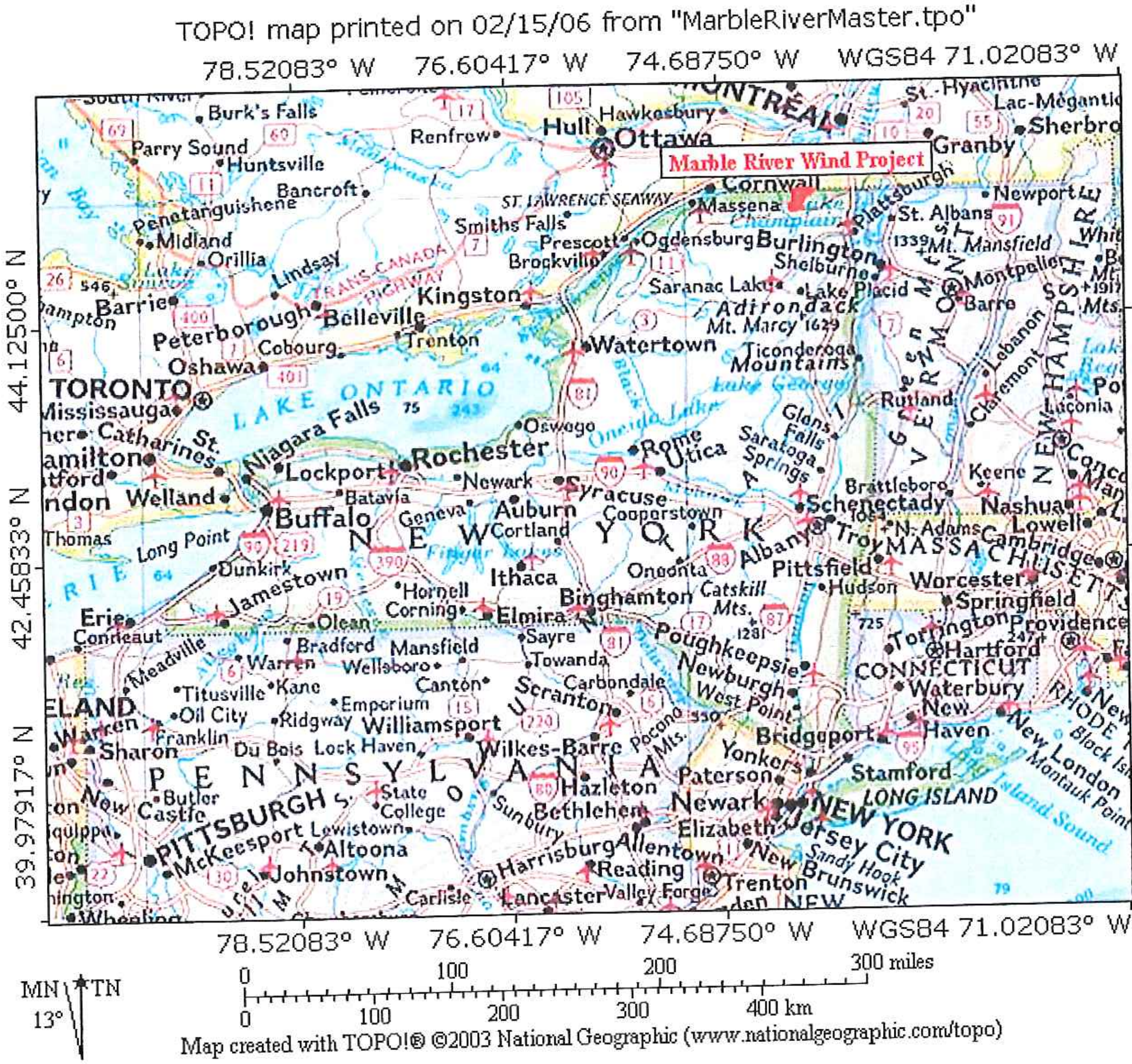


Figure 2. Marble River Wind Project Location in Clinton County, New York.

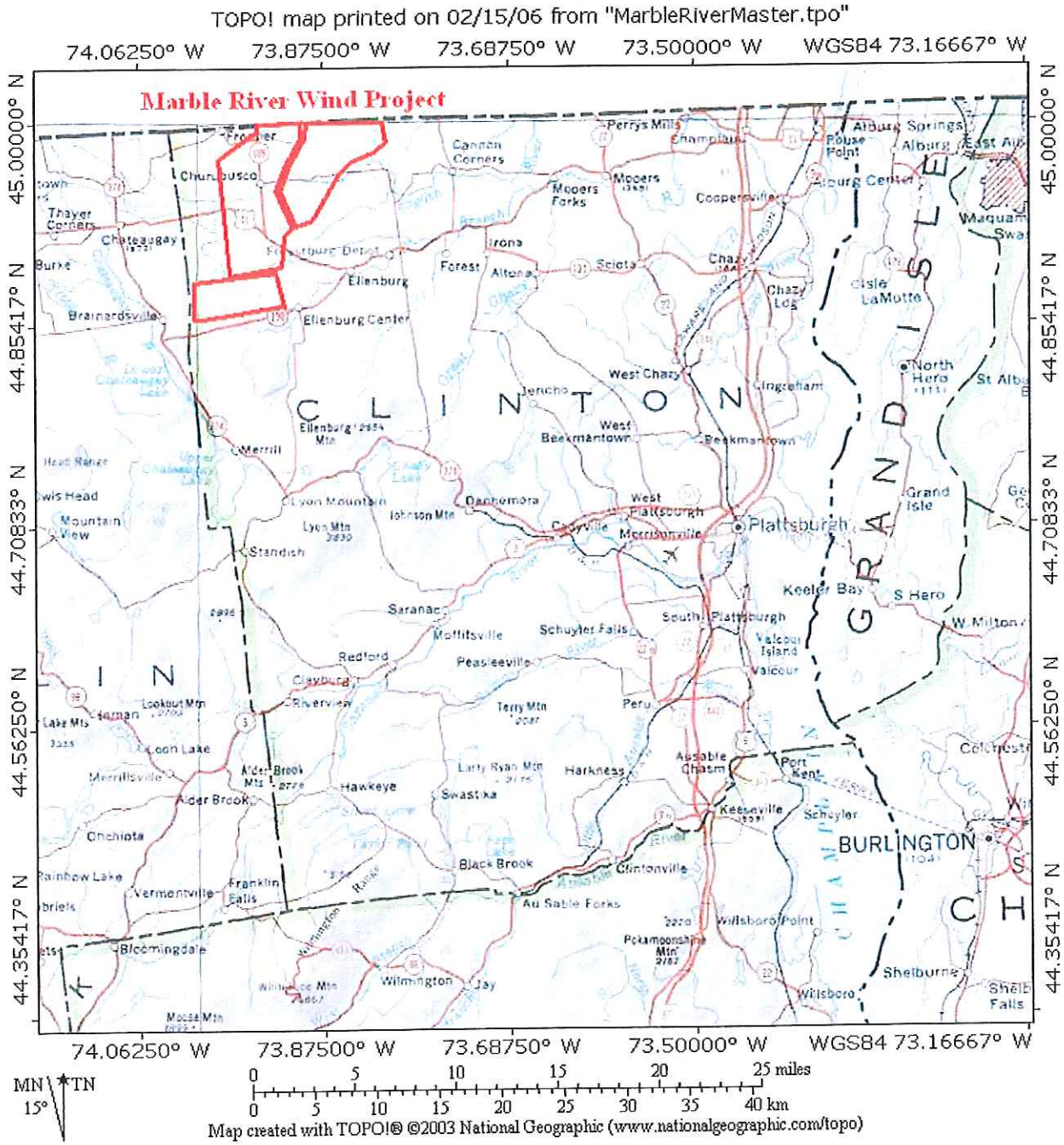
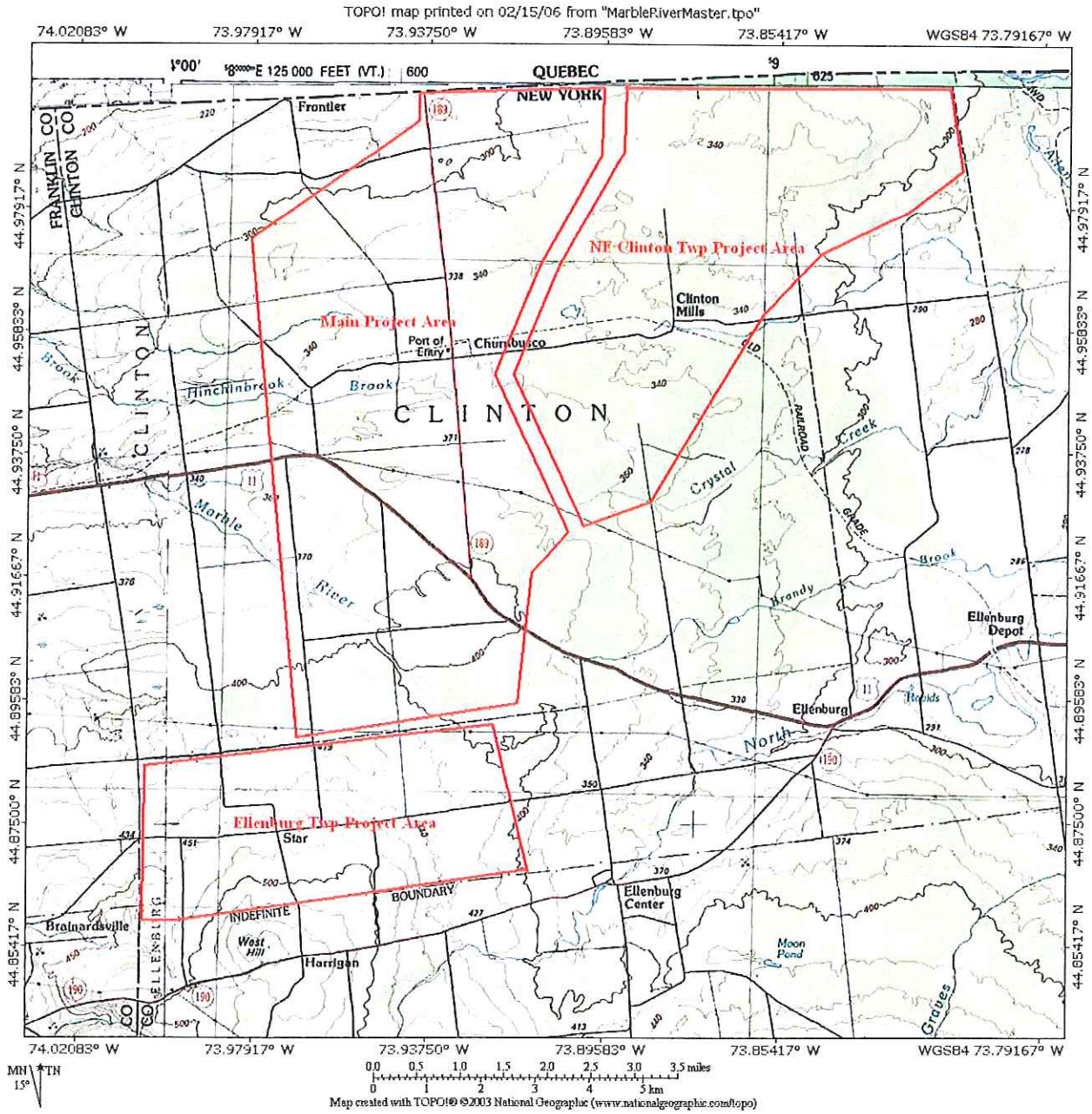


Figure 3. Topography and Forest Cover at the Marble River Wind Project Site (boundary approximate), Clinton County, New York. Main and Clinton are now referred to as the Clinton area for the Project.



1.0 Introduction

Because it is a clean, renewable energy source, wind power is generally considered to be one of the most environmentally benign sources of electrical power. However, direct and indirect impacts to birds have been documented at wind power sites in North America and Europe. These impacts have included collisions with turbine rotors and meteorology tower guy wires and displacement of nesting and feeding birds resulting from construction activities and large, new infrastructure. These types of potential impacts have become an issue among stakeholders – including wildlife agencies, local government officials, and the public – who often question the siting of new wind power projects.

A large wind-power project has been proposed for a site in northwestern Clinton County, New York, along the border with Canada. The project would have about 109 wind turbines, each with a nameplate capacity of between 2.0 MW, for a total project generating capacity of 218 MW. This report details an Avian Risk Assessment conducted for the Marble River Wind Project (hereafter referred to as the "Project").

The purpose of an avian risk assessment is to determine potential risk to birds at a proposed project site, along with the probability of that risk. Thus, the avian risk assessment is designed to guide developers, regulators, environmentalists, and other stakeholders through the risk assessment process at a particular site, including how evaluation of potential impacts may require further study. This assessment includes: 1) a site visit, 2) a literature and database search, 3) consultation and meetings with wildlife agencies regarding endangered and threatened species, as well as other wildlife concerns, and 4) site-specific field research on breeding birds, nocturnal songbird migration, and other avian phenomena. In addition, this report addresses compliance issues and recommendations now being made by the U.S. Fish and Wildlife Service (USFWS) in its *Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines* (USFWS 2003; Appendix A).

A site visit is undertaken by an avian expert skilled in bird identification and habitat evaluation. 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-concern 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 USFWS records, New York State Natural Heritage Program (NYSNHP) records, New York Breeding Bird Atlas (BBA), North American Breeding Bird Surveys (BBS), Audubon Christmas Bird Counts (CBCs), hawk migration literature and newsletters (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, USFWS and NYSDEC – to request information they may have on listed species at or near the Project site (Stilwell letters 2004, 2005, Ketchum letters 2004, 2005). These letters seek to improve knowledge of the Project 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. In addition, an in-person meeting is sometimes conducted with agency biologists.

Finally, in some risk assessments, field studies are conducted to gain a more in-depth understanding of site-specific bird use. These may include a breeding bird field study, nocturnal radar study, raptor migration study, and sometimes other studies.

The information developed from the site visit, literature and database searches, wildlife-agency consultations, and field studies is then integrated into a report, such as this one. The report summarizes habitat and birds likely to be present at a site, potential risk of wind turbine construction at the site, a comparison the project site with other sites where risk has been determined (with special consideration given to wind power projects in the Northeast region), and recommendations for further studies and mitigation, if indicated.

2.0 Project and Site Description

2.1 Project Description

The proposed Marble River Wind Project would be located in extreme northern New York State along the border with Quebec Province, Canada (see Figure 1). Located in northwestern Clinton County (see Figure 2), the site is about 25 miles (40 km) northwest of Plattsburg and about 40 miles (64 km) east of Massena.

AES and Horizon Wind Energy, the Project proponents, have identified two adjacent areas in the towns of Clinton and Ellenburg to develop their wind energy project (see Figure 3). They propose 109 wind turbines, each with a nameplate capacity of 2.0 MW (total project capacity of 218 MW). Tower heights would be 78 m (256 feet) with a rotor length of 44 m (144 feet). Maximum height of the rotor tip when the rotor is in the 12 o'clock position would be 125 m (410 feet) above ground level (AGL). In the 6 o'clock position, the rotor tip could be as low as 37 m (121 feet) AGL.

Turbines would be mounted on steel tubular 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 82 m (269 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 would be constructed somewhere on the Project site. The connection between the substation and existing transmission lines could be above ground.

2.2 Site Description

The Marble River Wind Project would be constructed in two sections, hereafter referred to as Clinton and Ellenburg (please see Figure 3). The approximate dimensions, elevations, installed capacity, and forest cover of each can be found in Table 2.1-1.

Table 2.1-1. Project Dimensions and Forest Cover

Project Section	Dimensions E-W *Miles*[1]	Dimensions N-S *Miles*[1]	Approx. Area *Sq. Mi.*[2]	Elevation Range *Feet*[3]	Approx. Number Turbines	Approx. Capacity *MW*	Approx. Forest Cover
Clinton	3.3	5.0-7.4	40.9	900-1,350	89	178	60%
Ellenberg	4.4	2.0	8.8	1,300-1,740	20	40	15%
			49.7		109	218	52%

[1] To convert to km, multiply by 1.6.

[2] To convert to km^2, multiply by 2.56.

[3] To convert to m, divide by 3.28.

The New York Atlas and Gazetteer, USGS topographic maps viewable through National Geographic's TOPO! mapping software, and various literature sources (Andrle and Carroll 1988, Levine 1998, and Burger and Liner 2005) 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 October 31-November 1, 2005, and by field studies (Woodlot 2005b). This research facilitated an overview of the bird communities and species that are likely to be present.

Regarding topography at the Project site, the land gently rises in a north to south direction from the border with Canada up toward the boundary with the Adirondack Park. The land also drops off to the east toward Lake Champlain. Elevations range from 900 to 1,740 feet (275 to 530 m). To the south of the Project site, in Adirondack Park, the topography becomes mountainous.

It is interesting to note that the Project site is on the divide between two major water drainages. Streams originating on the west side of the Project site flow northwest toward the St. Lawrence River. Those on the east side flow east toward Lake Champlain. There is a high representation of swamps where forest cover predominates at the Project site, such as in the Clinton section.

Regarding physiography, the Project site is located at the junction of three ecozones: Champlain Transition, St. Lawrence Plains (Malone Plain subzone), and Western Adirondack Transition (Andrle and Carroll 1988, Levine 1998). Therefore, the physiography of the Project site would be a mixture of each, with one blending into another and with some areas having more characteristics of one ecozone than another. Based on the map presented in Levine, the Champlain Transition appears dominant. This ecozone is described as having gentle topography combined with productive soils. Forests consist mainly of aspen, birch, and northern hardwoods

with some white pine, red spruce, and balsam fir. Nonetheless, the low swampy areas of the Project site, particularly in the Clinton section, are more characteristic of the St. Lawrence Plains, where soils are of medium productivity, and land abandonment has resulted in considerable shrubland. The Western Adirondack Transition is an area of poor soils and rougher topography, where old fields, successional forests, and farms occur. It would occur at the Project site's upper elevations.

In the topographic maps, three major habitats appear: agricultural fields, woodlands, and wetlands. Woodland cover varies significantly between Project sections (see Table 2.1-1). The highest representation of woodland (~60%) is in the Clinton section, where swampland and bogs (the main wetland types) must have historically limited agricultural uses. There, most wind turbines would be erected in upland woods out of the swampy low areas. At the other end of the spectrum (15% woodland cover), Ellenburg is mainly open fields, where likely all of its wind turbines will be erected. Turbine placements may be biased toward open areas, but a significant number will be placed in woodlands. To the south of the Project site, forest cover predominates in the rough terrain and poor soils of the Adirondacks.

The entire Project is crisscrossed by roads, along which are situated houses and farms. There also appears to be two electrical transmission lines crossing portions of each Project section. In general, the lands where the turbines would be located have been highly disturbed by farming or logging practices.

3.0 Results of Site Visit

The site of the proposed Marble River Wind Project was visited on October 31 and November 1, 2005. All areas accessible by road were toured by automobile and some areas were walked. Weather both days was fair, with temperatures mostly in the fifties, light to moderate winds out of the south, and cloud cover building to completely overcast late in the day with light rain. Photographs showing representative habitat are provided in Appendix B.

Based on a first-hand examination of the Project site, the habitats at the different Project sections can be described as follows. We have divided the Clinton section into two separate sections: Clinton and Main, as shown in Figure 3 to better describe this large area.

Ellenburg: This section was mostly agricultural fields (hay, clover, corn, and pasture) with woodlots. These woodlots were mainly second growth with few large trees. Common trees included gray birch, quaking aspen, bigtooth aspen, black cherry, and American beech. Other trees noted were American elm, paper birch, yellow birch, pin cherry, sugar maple, red maple, apple, eastern white pine, and northern white cedar. Spruce, and balsam fir were also common, both scattered about and in pure stands. Red pine plantings were also present. There was also a dense growth of alder and shrubby willows in some wetland areas.

Clinton (Main Section in Figure 3)**:** This section had agricultural fields (hay, clover, corn, and pasture) with both woodlots and more extensive wooded areas. In addition to the tree species noted for the Ellenburg section, the following species were also recorded here: American basswood, eastern hemlock, black willow, ash, tamarack, and staghorn sumac. Woodland

coverage included some fairly large pure stands of spruce and fir. The wooded areas were mostly second growth, but there were a few areas with larger trees mixed in. Some older successional fields were also present. Wetland habitats included cattail marshes, wet meadows with grasses and sedges, small streams, alder and shrubby willow thickets, small ponds, and a very extensive, fairly open tamarack and spruce bog (at Swamp Road east of Rt. 189 and Lagree Road). Some dense stands of northern white cedar were also noted.

Clinton (Clinton Section in Figure 3)**:** This section had extensive woodland throughout. Although there were a few areas with larger trees, the vast majority of these woods were a dense second growth, the result of intensive logging. Gray birch was by far the most dominant species. Other species present included red maple, black cherry, quaking aspen, bigtooth aspen, American beech, yellow birch, paper birch, tamarack, pin cherry, American basswood, northern red oak (very few), eastern white pine, and northern white cedar. There were also some stands of spruce and balsam fir, with some fairly extensive. Wetland habitats included beaver pods, several fairly large man-made ponds, streams, wet meadows with grasses and sedges, cattail marshes, and some very extensive bogs with alder and shrubby willows. There were also a few hay fields and pastures at the eastern edge of the site and one older successional field (east of Roberts Road).

Regarding birdlife, the site visit recorded 50 species (see list in Appendix C). The landbirds were mostly common resident, late migratory, and wintering birds of open and wooded habitats in northern New York State. Seven species of waterbirds were recorded – Snow Goose, Canada Goose, American Black Duck, Mallard, Northern Pintail, Hooded Merganser, and Ring-billed Gull. Five diurnal raptors were noted – Northern Harrier (threatened), Sharp-shinned Hawk (special concern), Red-tailed Hawk, Rough-legged Hawk, and American Kestrel. Agricultural grassland birds included Horned Lark (special concern), Savannah Sparrow, and Snow Bunting.

Three species on the NYSDEC list of endangered, threatened, and special-concern species were recorded, but these birds likely derived from breeding populations north of New York State that are not listed. They were the threatened Northern Harrier and special-concern Sharp-shinned Hawk and Horned Lark.

4.0 Avian Overview of the Marble River Wind Farm Project

The North American Landbird Conservation Plan (Rich et al. 2004) locates the Marble River Wind Project site in the Lower Great Lakes/St. Lawrence Plain (Bird Conservation Region # 13) of the Eastern Avifaunal Biome, a region covering the eastern United States. According to Rich et al., much of this biome was once covered by forest, but large regions have been converted to agriculture, plantation forestry, or urban development. The biome's major conservation issues are related to the effects of such conversions on bird habitats.

Rich et al. state that the vast majority of continentally important breeding birds in the Eastern Avifaunal Biome are Neotropical migrants. The breeding avifauna shifts in winter to the extreme southeastern U.S. south and west to coastal Texas, eastern Mexico, the Greater Antilles, Central America, and into South America. Arctic Avifaunal Biome breeders winter in portions of the Eastern Avifaunal Biome. Between 121 and 150 landbird species are recorded as breeding

in the various habitats of the Lower Great Lakes/St. Lawrence Plain, but only between 41 and 80 landbird species occur in winter (Rich et al. 2004).

Rich et al. list the primary habitats in the Eastern Avifaunal Biome as deciduous and coniferous forest, shrub/successional habitats, wetlands, and grassland. The main conservation issues are urban development and population growth, resulting in loss and fragmentation of bird habitats; forest maturation, resulting in a lack of successional habitats; mountaintop-removal-valley-fill mining, threatening the removal of up to 20% of diverse mixed-mesophytic and oak-hickory forests critical to such species as the special-concern Cerulean Warbler; and changes in and intensification of agricultural practices, reducing habitat suitability for grassland birds.

A seasonal look at the avifauna at the Marble River Project site follows. This analysis is based on the site visit, literature review, agency consultations, and field studies.

4.1 Nesting Birds

Table 4.1-1 summarizes the NYSDEC and USFWS 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).

It is worth noting that, in terms of landbirds, only six of the 26 landbird species listed in Table 4.1-1 are considered Watch List Species by Partners in Flight (PIF). Formed in 1990, PIF is a partnership of federal, state and local government agencies, philanthropic foundations, professional organizations, conservation groups, industry, the academic community, and private individuals committed to conserving the landbirds that occupy every major biome and habitat in North America. The PIF Watch List for Landbirds includes 100 species that have the greatest range-wide concerns and are in most need of conservation attention in North America. The Watch List species also on the New York endangered, threatened, or special-concern list are the endangered Short-eared Owl, threatened Henslow's Sparrow, and special-concern Red-headed Woodpecker, Golden-winged Warbler, Cerulean Warbler, and Seaside Sparrow. Some Watch List species that breed in New York State, may occur at the Project site, but are not on the NYSDEC list include Olive-sided Flycatcher, Willow Flycatcher, Wood Thrush, Blue-winged Warbler, Prairie Warbler, and Canada Warbler.

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

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

[1] E = Endangered, T = Threatened, and SC = Special Concern.

[2] BBA = Breeding Bird Atlas. Please see Table 4.1-2 for details.

[3] BBS = Breeding Bird Survey. Please see Table 4.1-3 for details.

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

Based on a visual evaluation of habitats outside of the breeding season, the site visit found that a number of New York-listed species could conceivably breed at the Project site and vicinity. These species may be:

- **Pied-billed Grebe (threatened):** Could conceivably breed in the extensive wetlands of the Clinton section.
- **Least Bittern (threatened):** Could conceivably breed in cattail marshes and other extensive wetland areas found in the Clinton section.
- **Northern Harrier (threatened):** Could use larger agricultural fields and extensive wetlands to breed.
- **Upland Sandpiper (threatened):** Could conceivably breed in larger agricultural fields.
- **Sedge Wren (threatened):** Could occur in the numerous wet meadows with grasses and sedges.
- **Common Loon (special concern):** Potential breeder on the larger ponds in the Clinton section.
- **American Bittern (special concern):** Likely breeder in the extensive wetlands in the Clinton section.
- **Osprey (special concern):** Probable nest found at Alex Pond in the Clinton section.
- **Sharp-shinned Hawk (special concern):** Potential breeder in wooded sections.
- **Cooper's Hawk (special concern):** Potential breeder in wooded sections.
- **Northern Goshawk (special concern):** Potential breeder in wooded sections, but less likely than previous two species.
- **Red-shouldered Hawk (threatened):** Potential breeder in wooded sections, particularly in the Clinton section with its extensive wetlands.
- **Common Nighthawk (special concern):** Possible breeder.
- **Whip-poor-will (special concern):** Possible breeder.
- **Horned Lark (special concern):** Potential breeder in agricultural areas.
- **Golden-winged Warbler (special concern):** Likely breeder in extensive cut-over second-growth areas, especially in the Clinton section.
- **Vesper Sparrow (special concern):** Potential breeder in agricultural areas.
- **Grasshopper Sparrow (special concern):** Could conceivably breed in grassland areas.

Letters from USFWS received in 2004 and 2005 did not indicate the presence of federally listed species. However, letters from the NYSDEC revealed that Common Loon (species of concern) and Least Bittern (threatened) may nest on or near the Project site.

Two data sources were examined to determine the likely breeding bird community and the potential presence of listed bird species in and around the Marble River Project site. One was the New York Breeding Bird Atlas (BBA), the coverage of which included the Project site. Another source was nearby Breeding Bird Surveys (BBS) of the U.S. Geological Survey (USGS). One BBS route appears to have crossed or abutted the Clinton section, and nearby routes surveyed similar habitats in the St. Lawrence Plains and Lake Champlain Transition. Detection of any listed species, or suitable habitat for these species, in either of these information sources signaled that these species might be found on or near the proposed wind power site.

In addition, Woodlot Alternatives, Inc. (Woodlot) was contracted by the Project proponents to conduct a breeding bird field survey (BBFS) in field and woodland habitats mainly in a part of the Clinton section (southern portion of the Main section (Figure 3) of the Project site. The results of this site-specific study are also reported.

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.state.ny.us/apps/bba/results/).

The BBA project divided the entire state into ten regions (the Project site is in Region 7) 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.).

Fourteen blocks covered portions of the Marble River 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 ranged from 91 to 36 species, with 135 species recorded cumulatively (see Appendix D for a complete list, including from the various Project sections). Of this number, 68 species (50%) were confirmed as breeders, 37 (27%) were recorded as probable breeders, and 30 (22%) were listed as possible breeders.

Nearly all of the species recorded in the 2000-2005 BBA were common nesting species for this region of New York State. But, one endangered, two threatened, and nine special-concern species were recorded (see Table 4.1.1-1 and discussion below).

Given the extensive swamplands and bogs in the Clinton section, waterbirds were fairly well represented in the BBA survey. Confirmed and probable breeders included American Bittern (special concern), Great Blue Heron, Canada Goose, Wood Duck, Mallard, Virginia Rail, Spotted Sandpiper, Wilson's Snipe, and American Woodcock. Seven other species were recorded once or twice as possible breeders, including the threatened Pied-billed Grebe, other ducks, and the Sora rail (see Appendix D).

4.1-2. Breeding Bird Atlas (BBA) Records of Listed and Special-Concern Species

Block Number	Project Section[1]	Total Species	Listed Species[2]	Breeding Status	Notes
5798D	Main	41	Northern Harrier (T)	Possible	Recorded in possible nesting habitat
5797B	Main	81	American Bittern (SC)	Possible	Recorded in possible nesting habitat
			Northern Harrier (T)	Possible	Recorded in possible nesting habitat
			Sharp-shinned Hawk (SC)	Possible	Recorded in possible nesting habitat
			Vesper Sparrow (SC)	Probable	Singing male at same place on more than one date
5797D	Main	78	Northern Harrier (T)	Probable	Bird observed visiting probable nest site
			Horned Lark (SC)	Possible	Recorded in possible nesting habitat
			Vesper Sparrow (SC)	Probable	Singing male at same place on more than one date
5897C	Main	66	Northern Harrier (T)	Probable	Pair observed in suitable nesting habitat
			Vesper Sparrow (SC)	Confirmed	Recently fledged young observed
5898C	Clinton	88	American Bittern (SC)	Confirmed	Recently fledged young observed
			Cooper's Hawk (SC)	Possible	Recorded in possible nesting habitat
			Grasshopper Sparrow (SC)	Possible	Recorded in possible nesting habitat
5898D	Clinton	77	Osprey (SC)	Possible	Recorded in possible nesting habitat
			Peregrine Falcon (E)	Possible	Recorded in possible nesting habitat
5998C	Clinton	91	American Bittern (SC)	Possible	Recorded in possible nesting habitat
			Northern Harrier (T)	Possible	Recorded in possible nesting habitat
			Sharp-shinned Hawk (SC)	Possible	Recorded in possible nesting habitat
			Peregrine Falcon (E)	Possible	Recorded in possible nesting habitat
5897A	Clinton	66	Northern Harrier (T)	Possible	Recorded in possible nesting habitat
			Sharp-shinned Hawk (SC)	Possible	Recorded in possible nesting habitat
			Cooper's Hawk (SC)	Possible	Recorded in possible nesting habitat
			Whip-poor-will (SC)	Possible	Recorded in possible nesting habitat
5897B	Clinton	74	Northern Harrier (T)	Possible	Recorded in possible nesting habitat
			Whip-poor-will (SC)	Possible	Recorded in possible nesting habitat
			Vesper Sparrow (SC)	Possible	Recorded in possible nesting habitat
5997A	Clinton	77	American Bittern (SC)	Possible	Recorded in possible nesting habitat
			Cooper's Hawk (SC)	Possible	Recorded in possible nesting habitat
			Common Nighthawk (SC)	Probable	Pair observed in suitable nesting habitat
5797C	Ellenburg	80	Pied-billed Grebe (T)	Possible	Recorded in possible nesting habitat

Block Number	Project Section[1]	Total Species	Listed Species[2]	Breeding Status	Notes
			American Bittern (SC)	Possible	Recorded in possible nesting habitat
			Horned Lark (SC)	Confirmed	Recently fledged young observed
			Vesper Sparrow (SC)	Probable	Singing male at same place on more than one date
5796A	Ellenburg	43			
5796B	Ellenburg	36			
5896A	Ellenburg	55	Cooper's Hawk (SC)	Possible	Recorded in possible nesting habitat

[1] Principal section covered, but may have contained smaller portions of other Project sections. Main section is part of the Clinton section (Figure 3).

[2] E = Endangered, T = Threatened, and SC = Special Concern; please see Table 4.1-1.

Three raptors were confirmed as breeders: Turkey Vulture, Broad-winged Hawk, and American Kestrel. Surprisingly, Red-tailed Hawk was recorded in only four of the fourteen blocks, only once as a probable breeder and three times as possible. The threatened Northern Harrier was recorded in half of the blocks, including twice as a probable breeder in blocks that overlapped the Main section (part of Clinton section (Figure 3). Other raptors recorded as possible included the special-concern Osprey (once in the Clinton section) and Sharp-shinned and Cooper's Hawks (in three and four blocks respectively from more than one Project section). Of great surprise were three records of Merlin and two of the endangered Peregrine Falcon. These records were from different years, indicating that both species use the Project site infrequently for hunting.

A wide variety of landbirds were recorded, including many of the species one would expect in woodland, woodland-edge, shrubland, agricultural field, grassland, and wetland habitats. Many were confirmed as breeders. These included gamebirds, doves, owls, nightjars, woodpeckers, flycatchers, vireos, corvids, swallows, tits, nuthatches, wrens, kinglets, thrushes, warblers, sparrows, icterids, finches, and other species. Many were recorded in most of the BBA blocks. Please see D for a complete list.

Regarding grassland-specialty species, the following were recorded in half or more of the blocks: Northern Harrier (threatened), Savannah Sparrow, Bobolink, and Eastern Meadowlark. Others were recorded in less than half of the blocks, specifically the special-concern Horned Lark, Vesper Sparrow, and Grasshopper Sparrow (discussed below).

Regarding woodland and woodland-edge species, most were common birds. But, the special-concern Common Nighthawk and Whip-poor-will were sparingly recorded (see discussion below). Of interest were the following PIF Watch List species: Olive-sided Flycatcher (in three blocks, once as probable), Willow Flycatcher (in one block as possible), Wood Thrush (in seven blocks, twice as probable), and Canada Warbler (in six blocks, once as confirmed and twice as probable).

Regarding listed species (see Table 4.1-2), the endangered Peregrine Falcon was observed twice in different years in the Clinton section (June 2001 and July 2004). These records indicate that the Peregrine hunts at the Project site on occasion. The cliff ledges this species requires for nesting are not found in the Project vicinity, however.

The threatened Pied-billed Grebe was recorded as a possible breeder, the lowest status, in the vicinity of the Ellenburg section. Topographic maps show no suitable nesting habitat for the grebe in that area. But, the site visit found that the Clinton section does have what can be considered suitable nesting habitat.

The threatened Northern Harrier was recorded in the Clinton section. Two of the records in the southern part of the Main section (of Clinton section, Figure 3) were probable – an adult appearing to visit a probable nest site, and a pair observed in probable nesting habitat.

As for the special-concern species, American Bittern was recorded in five blocks, including a confirmation in the Clinton section, where recently fledged young were observed.

Osprey was recorded once as possible in the Clinton section, where the site visit found a nest. Sharp-shinned Hawk and Cooper's Hawk were recorded only as possible breeders (probably observations of single birds) in three and four blocks respectively, with the majority of records in the heavily wooded Clinton section. Because these raptors occur at relatively low densities and are generally difficult to observe, these records probably indicate summer resident birds.

Common Nighthawk and Whip-poor-will were recorded one and twice respectively in the Clinton section. In the case of the nighthawk, a pair was observed, indicating probable nesting somewhere in the area. Both records for the Whip-poor-will only indicated possible breeding.

Three special-concern agricultural grassland specialists were recorded. The Horned Lark was recorded in two blocks, but one of the records in or near the Ellenburg section was a confirmation (recently fledged young). The other record was likely a single sighting in the Main section (of the Clinton section, Figure 3). Vesper Sparrow was recorded in five blocks, including a confirmation and two probable records in the Main section of the Clinton section and one probable record in the Ellenburg section. The other record was as possible in the Clinton section. Grasshopper Sparrow was recorded only as possible in one block that overlaps the northeast Main section (of the Clinton section, see Figure 3) and northwest Clinton section (Figure 3). These records indicate that Vesper Sparrow would be the special-concern agricultural grassland bird most likely to be encountered at the Project site in suitable habitat, with Horned Lark and Grasshopper Sparrows occurring at lower densities.

Looking at 2000-2005 BBA results for endangered and threatened species in region around the Project site (above Adirondack Park and away from the St. Lawrence River and Lake Champlain), only Pied-billed Grebe, Northern Harrier, and Upland Sandpiper were recorded. Northern Harrier was recorded at the highest density, with a solid band of records across the Project region. Records for Pied-billed Grebe were fairly scattered, while there were very few records for the Upland Sandpiper.

Regarding records of special-concern species in the border region with Canada (north of Adirondack Park), Vesper Sparrow was the only species recorded in a band across northern Franklin and Clinton counties. There were a cluster of Horned Lark records from the Project site to just west of it. Records for American Bittern, Cooper's Hawk, Common Nighthawk, and Whip-poor-will were clustered mainly east of the Project site. Records were fairly scattered for Osprey, Sharp-shinned Hawk, and Red-shouldered Hawk across this region, and very scattered for Common Loon, Northern Goshawk, Red-headed Woodpecker, Golden-winged Warbler, and Grasshopper Sparrow. There were no records for Cerulean Warbler. In other words, few special-concern species are relatively well distributed in the region around the Project site, with only Vesper Sparrow and Horned Lark showing clusters of records there.

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. At each stop, a three-minute point count is conducted. During the 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.

Four BBS routes are located within 15 miles (24 km) of the Project site and sample bird habitat in Clinton and Franklin counties and in adjacent Quebec Province. These routes have been analyzed in order to gain a different perspective on the breeding bird community in the Project region and to evaluate the likelihood of the occurrence of listed species as breeders at the Marble River Project site (see Table 4.1.2-1). One of these routes (Ellenburg) crosses or abuts a portion of the Clinton section of the Project site. Data analysis was limited to the last ten years, beginning in 1996.

The list of birds recorded along these BBS routes is essentially the same as that derived from the BBA data. The BBS data, however, gives an indication of frequency. For example, on the Ellenburg route, no species was recorded above 100 birds/route (40 birds/hour). Twenty-one species (29% of the cumulative 71 species recorded) were recorded above 10 birds/route (4 birds/hour) in at least one of the two years that route was surveyed. They were Rock Pigeon, Mourning Dove, Alder Flycatcher, Red-eyed Vireo, Blue Jay, American Crow, Tree Swallow, Barn Swallow, Eastern Bluebird, American Robin, European Starling, Yellow Warbler, Chestnut-sided Warbler, Ovenbird, Common Yellowthroat, Song Sparrow, White-throated Sparrow, Bobolink, Red-winged Blackbird, Common Grackle, American Goldfinch, and House Sparrow. All other species were generally recorded much below 10 birds/route (often at one or two birds per route), in many cases not every year. This gives a good idea of the prominent bird life in the agricultural and wooded landscape around the Project site.

On the Ellenburg route, waterbird diversity and numbers were generally low. Only five species were recorded – Canada Goose, Mallard, American Bittern (special concern), Great Blue Heron, and Wilson's Snipe – with all under 10 birds per route. On the other routes, Wood Duck, American Black Duck, Double-crested Cormorant, Great Egret, Green Heron, Black-crowned Night-Heron, Spotted Sandpiper, and Ring-billed Gull were additionally recorded. Numbers were generally below 10 birds per hour, but some species exceeded this frequency in one year or more on at least one route. They were Canada Goose, American Black Duck, Mallard, and Ring-billed Gull.

Seven species of diurnal raptors were recorded on the four routes: Turkey Vulture, Northern Harrier (threatened), Sharp-shinned Hawk (special concern), Cooper's Hawk (special concern), Red-shouldered Hawk (special concern), Broad-winged Hawk, and American Kestrel. Oddly, no Red-tailed Hawks were recorded. American Kestrel was the species most frequently recorded, found on three of the four routes, but never above 2 birds per route. The special-concern Cooper's Hawk and Red-shouldered Hawk were found on two routes each, with single birds in the few years recorded. The threatened Northern Harrier and special-concern Sharp-shinned Hawk were found on only one route. Turkey Vulture was recorded on only one route.

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

Route Number	Route Name	County/Province	Distance/ Bearing from Site	Years Analyzed	Species Max/Min	Listed Species[1]	% Years Recorded	# Birds /Year
61108	Ellenburg	Clinton	0 mi	2	60 / 59	American Bittern (SC)	50%	2
61112	Sciota	Clinton	1 mi E	2	63 / 56	American Bittern (SC)	50%	1
						Cooper's Hawk (SC)	50%	1
76304	Chateau Guay	Quebec	3 mi E	9	69 / 49	Northern Harrier (T)	44%	1-2
						Red-shouldered Hawk (SC)	22%	1
						Upland Sandpiper (T)	44%	1-4
						Common Nighthawk (SC)	22%	1
						Horned Lark (SC)	100%	4-16
61105	West Bangor	Franklin	13 mi W	2	66 / 65	Sharp-shinned Hawk (SC)	50%	1
						Red-shouldered Hawk (SC)	50%	1

[1] NYSDEC status, E = Endangered, T = Threatened, and SC = Special Concern; see Table 4.1-1.

Regarding listed species, two threatened and six special-concern species were recorded infrequently (see Table 4.1.2-1). The two threatened species – Northern Harrier and Upland Sandpiper – were only recorded on the Chateau Guay route in adjacent Canada. Their records may have to do with agricultural practices in Canada that favor these species. Both species were recorded in four of nine years. For the harrier, single birds were found in three years, with two birds in one year. For the sandpiper, four birds were found in one year, two birds in two years, and one bird in one year.

The six special-concern species were American Bittern, Sharp-shinned Hawk, Cooper's Hawk, Red-shouldered Hawk, Common Nighthawk, and Horned Lark. Only the bittern and Red-shouldered Hawk were found on as many as two routes. Horned Lark was the only species frequently recorded on the route where it was found – in nine of nine years on the Chateau Guay route, with a low of four birds and a high of sixteen. This again probably has to do with favorable agricultural practices for grassland birds in adjacent Canada.

4.1.3 Breeding Bird Field Survey (BBFS) Analysis

In June 2005, Woodlot Alternatives, Inc. (Woodlot 2005b) conducted a breeding bird field survey (BBFS) at the Project site. This survey was conducted in the southern part of the Main section (portion of the Clinton section, Figure 3) and extreme southwest portion of the Clinton section, covering areas where wind turbines and a transmission line would be constructed. Modeled after the BBS, all birds seen or heard during a five-minute interval at each of 30 survey points during peak songbird activity (between 4:30 and 9:30 AM) were documented. Survey points were well spaced to ensure against the double-counting of individuals. Fifteen points were sampled per day on two consecutive mornings. The survey was repeated one week later to identify breeding birds during the peak nesting season. About half of the survey points were established in field habitat, the other half in wooded habitat. This methodology allowed calculations of relative abundance, species richness, and frequency of breeding avian species over the survey area and by habitat type.

Excluding flyover birds or birds beyond 100 m (328 feet) of the survey point, 336 bird records of 53 species were included for numerical analysis. The number of bird records per survey point ranged from 8 to 16. The overall relative abundance (i.e., number of birds recorded per survey point in both surveys) was 5.60. This value was slightly higher in field habitat (5.71) than in wooded habitat (5.50). The number of species recorded per survey point ranged from 5 to 12 species, yielding a mean species richness of 8.4. Species with the overall highest relative abundance were Song Sparrow, White-throated Sparrow, Black-capped Chickadee, and Black-and-white Warbler.

In field habitat, 33 species were recorded, of which 17 were unique to the field habitat (i.e., not recorded in woodland habitat). Table 4.1.3-1 presents the most abundant birds in each principal habitat type, including their frequency of occurrence. The most abundant field birds were Song Sparrow, Red-winged Blackbird, American Robin, Bobolink, and Savannah Sparrow, which accounted for nearly 50% of the total observations. Species observed in half or more of the field survey points were Song-Sparrow, American Robin, Red-winged Blackbird, and White-throated Sparrow.

Table 4.1.3-1. Bird Abundance per Habitat Type in BBFS
From Woodlot 2005

Field (14 survey points)	RA[1]	FR[2]	**Woodland** (16 survey points)	RA[1]	FR[2]
Song Sparrow	1.04	79%	White-throated Sparrow	0.67	87%
Red-winged Blackbird	0.57	64%	Black-capped Chickadee	0.60	73%
American Robin	0.43	64%	Black-and-white Warbler	0.47	67%
Bobolink	0.36	29%	Veery	0.43	53%
Savannah Sparrow	0.32	36%	Yellow Warbler	0.43	80%
Chipping Sparrow	0.29	36%	Black-throated Green Warbler	0.33	60%
White-throated Sparrow	0.29	50%	Rose-breasted Grosbeak	0.33	53%
Eastern Phoebe	0.21	29%	Chestnut-sided Warbler	0.20	33%
Horned Lark	0.21	29%	Common Yellowthroat	0.20	40%
Common Yellowthroat	0.18	29%	Eastern Phoebe	0.17	27%
Grasshopper Sparrow	0.18	29%	Red-breasted Nuthatch	0.17	33%
Eastern Meadowlark	0.18	36%	American Robin	0.17	27%
Killdeer	0.14	21%	Red-eyed Vireo	0.13	27%
American Woodcock	0.14	29%	Ruffed Grouse	0.10	20%
Black-and-white Warbler	0.14	29%	Blue-headed Vireo	0.10	20%
American Crow	0.11	21%	Cerulean Warbler (?)	0.10	13%
European Starling	0.11	21%			
Yellow Warbler	0.11	21%			
Baltimore Oriole	0.11	21%			

[1] Relative Abundance (total observations per survey point in both surveys combined; values of 0.10 and greater)

[2] Frequency (percent of survey points where species was recorded)

Grassland nesting birds included (in order of abundance) Bobolink, Savannah Sparrow, Horned Lark, Grasshopper Sparrow (special concern), and Eastern Meadowlark. No Vesper Sparrows (special concern) were recorded, although habitat at the site suggested they may be present. The Vesper Sparrow was well recorded in the 2000-2005 BBA both in the area covered by the BBFS (including a confirmed breeding record) and across northern Clinton and Franklin Counties. The Grasshopper Sparrow, on the other hand, was barely recorded both in the BBA blocks covering the Project site (in only one of 14 blocks as possible, the lowest status) or regionally (the above record being the only one in northern Clinton and Franklin Counties). Grasshopper Sparrow can easily be overlooked (the BBFS records were probably from vocalizations); therefore, its occurrence in the BBFS is no great surprise.

In woodland habitat, 35 species were recorded, of which 20 were unique to the woodland habitat. The most abundant of these were White-throated Sparrow, Black-capped Chickadee, Black-and-white Warbler, and Veery, which accounted for 52% of the total observations. Species found at half or more of the woodland survey points were White-throated Sparrow, Yellow Warbler, Black-capped Chickadee, Black-and-white Warbler, Black-throated Green Warbler, Veery, and Rose-breasted Grosbeak.

The records of the special-concern Cerulean Warbler are engimatic, especially the presence of four birds, one at a field point and three at two woodland points. The 2000-2005

BBA did not record the Cerulean at all in Clinton and Franklin Counties. The nearest records were clustered in far western St. Lawrence County. In addition, the habitat on site does not seem suitable for this species. Woodland at the Project site is fragmented or mainly younger second growth, not the tall deciduous forests in swamps, in stream bottoms, and along lake and river shores, or moist higher elevation forests, where Ceruleans are usually recorded (Andrle and Carroll 1988). In its discussion of the results, Woodlot Alternatives (2005b) focuses on a recent study (American Bird Conservancy 2000) that reports that the Cerulean Warbler population is expanding in forest fragments in the St. Lawrence Plain. It is doubtful that this expansion includes the kind of habitat found at the Project site.

Listed species recorded in the BBFS were the threatened Northern Harrier and special-concern Horned Lark, Cerulean Warbler, and Grasshopper Sparrow. The harrier was observed flying over grasslands and croplands. Because the harrier records were of flyovers, they were not included in the numerical analysis. As with the BBA and Ellenburg BBS route, the BBFS did not record the threatened Upland Sandpiper, reinforcing the conclusion that the Upland Sandpiper does not occur as a breeder at the Project site. Nonetheless, BBS Upland Sandpiper records from the more bird-friendly agricultural region of adjacent Canada indicate a source of birds that could attempt to nest at the Project site on occasion.

4.1.4 Nesting Birds, Conclusions

In summary, based on the site visit and analysis of the BBA, BBS, and BBFS data, the Project site has a diverse breeding bird community made up of mainly common species of field and woodland habitats. The commonest field species are Song Sparrow, Red-winged Blackbird, American Robin, and Bobolink, and the commonest woodland species are White-throated Sparrow, Black-capped Chickadee, Black-and-white Warbler, Veery, and Yellow Warbler (Woodlot Alternatives 2005b).

Waterbird diversity is not outstanding, with the common breeders appearing to be Canada Goose, Wood Duck, Mallard, and Wilson's Snipe. American Kestrel appears to be the most common breeding raptor, but other likely breeding raptors include Osprey (special concern), Northern Harrier (threatened), Sharp-shinned Hawk (special concern), Cooper's Hawk (special concern), Broad-winged Hawk, and Red-tailed Hawk. Among the grassland specialists, Bobolink and Savannah Sparrow are the most commonly occurring breeders, but Northern Harrier (threatened), Horned Lark (special concern), Vesper Sparrow (special concern), Grasshopper Sparrow (special concern), and Eastern Meadowlark also occur.

Regarding listed species, the BBA recorded the endangered Peregrine Falcon twice, but nesting habitat for this species is not found in the vicinity of the Project site. The threatened Pied-billed Grebe may breed in the larger marshes and ponds of the Clinton section. The threatened Northern Harrier was fairly well recorded in the BBA, with probable records in the southern part of the Main section (part of Clinton section as in Figure 3), and also recorded in the BBFS. The threatened Upland Sandpiper was recorded in adjacent Canada, but data appear to indicate that this species does not occur as a breeder at the Project site. The threatened Sedge Wren was not recorded in any of the surveys, but the site visit found suitable habitat for this

species. Breeding by the endangered Short eared Owl and Loggerhead Shrike and by the threatened Henslow's Sparrow appears highly unlikely.

Among the special-concern species, it appears that the American Bittern, Osprey, Sharp-shinned Hawk, Cooper's Hawk, Horned Lark, Vesper Sparrow, and Grasshopper Sparrow breed at the Project site in small numbers. Records for Red-shouldered Hawk, Common Nighthawk, and Whip-poor-will were fewer or less conclusive, lending uncertainty to their breeding at the Project site. None of the surveys recorded Golden-winged Warbler, but some of the shrubland habitat looked suitable in the Clinton section. Habitat at the Project site does not look suitable for the Cerulean Warbler. Northern Goshawk may also occur.

4.2 Migratory Birds

There are few major or significant migration stopover sites or migration "pathways" in northern New York, including the area of northwestern Clinton County where the Project would be located. The topography and habitat of the Project site, or anywhere nearby, does not indicate that it would be an ecological magnet (*sensu* Berthold 2001, Alerstam 1990) that would attract or concentrate migratory birds. Such topography and habitat is not similar to locations in New York State where large numbers of migrants are found. In all cases, migration is likely to be broad front in nature and proceed generally at altitudes above the sweep of the wind turbine rotors.

The sections that follow examine the migration of songbirds, hawks, and waterbirds (waterfowl, shorebirds, and others) in New York and at the Project site and vicinity.

4.2.1 Nocturnal Songbird Migration

This section first discusses nocturnal songbird migration over northern New York State in general, then focuses on a study specific to the Marble River Project site conducted by Woodlot Alternatives (2005a, 2005b).

All evidence suggests that the night migration of songbirds over northernmost New York State occurs over a broad front, with no large concentrations of these birds, and no instances of birds following topography, such as ridges and valleys. General surveys of night migration indicate that it occurs over broad fronts (Berthold 2001, Alerstam 1993, Eastwood 1967). 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." Berthold uses the term "broad front" to describe these migrations.

Radar studies conducted in the Eastern U.S. indicate that night migration by 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 the ridge-following hypothesis. Therefore, it appears that migration in the eastern U.S. is broad front in nature and spread evenly or randomly over hundreds of miles of migration front.

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 near the Marble River Project site that would concentrate migrants making stopovers.

There are two accounts from the northeastern U.S. that appear to suggest that birds do, at times, change migration direction when confronted by topographic features. In New Hampshire, at Franconia Notch, at the northern edge of the White Mountains, birds appear to turn when they encounter the massive topographic features of these mountains (Williams et al. 2001). This is similar to the European findings of birds flying through passes in the Alps and diverting around the Alps (Bruderer and Liechti 199). However, the Williams et al. (2001) report provides little information on high-flying migrants or migrants flying in other than a restricted location near Franconia Notch, so there is limited information from this site. A study done at two New York sites (one along the Hudson River, the other in the Helderberg Mountains, near Albany) suggested that birds might have been following the Hudson River (or the lights along the River) during fall migration (Bingman et al. 1982) when winds were strong from the west.

A bioacoustical study of noctural songbirds conducted by Evans and Rosenberg (1999) appeared to have demonstrated that night migrants in the central New York region follow topographic features. But this study had significant flaws. Evans and Rosenberg attempted to quantify numbers of migrants and determine species composition of nocturnal migrants at seven sites across central New York State in the early 1990s. Evans (pers. comm.) found that, in general, during the fall migration, fewer birds migrated over the western portion of the state south of Lake Ontario than farther east. Evans also suspected that fewer birds fly over the hilltops than through the valleys, because as they come south they encounter the hills between the Finger Lakes and follow valleys so as not to utilize large amounts of energy to climb the steep hills. He stated that birds did fly over the hilltops and some were judged to fly at less than 300 feet (93 m) above the ground.

There is no foundation in the scientific literature for the contention that night migrating birds follow ridges or valleys at topographic situations other than those similar to the Alps or other massive topographic structures. Because the acoustical devices used by Evans and Rosenberg (1999) are unlikely to detect higher flying migrants, studies based on acoustical devices are typically biased toward lower flying birds. In addition, a recent report by Farnsworth et al. (2004), in which results from acoustical studies were compared with those from radar

studies, indicated that the acoustical methods proved a poor indicator of the numbers of birds aloft. The degree of correlation between the two methods was so low (mostly not significant) as to discount the use of acoustical studies for estimating traffic rates of night migrants at given sites. Furthermore, there has never been confirmation that the acoustical method is a valid means of determining the volume of migration at a particular site.

The above studies indicate that neither the location nor the topography or habitat of the Project site suggests anything but broad front migration. Therefore, nocturnal migrants are not likely to be concentrated at or above the Project site.

This conclusion is reinforced by a marine surveillance radar study specific to the Marble River Project site conducted by Woodlot Alternatives (Woodlot 2005a, 2005b). Their fall 2005 radar study showed a migration traffic rate of 152 ± 16 targets per kilometer per hour. The overall mean migration altitude was 438 m ± 15 m (1,437 ± 49 feet) above ground level, with nightly means ranging between 259 m ± 14 m (850 feet ± 46 feet) and 704 m ± 92 m (2,310 feet ± 302 feet) above ground level. The percent of targets observed flying below 120 m (394 feet – the height of turbines when the rotor is in the 12 o'clock position), varied by night, from 0% to 32%. The seasonal average below 120 m was 5%. In other words, the great majority of nocturnal migrants flew at altitudes well above the height to be swept by the wind turbine rotors. Migration direction was to the west of south toward 193° ± 89°.

The spring radar study yielded similar results, but migratory traffic was slightly higher than the found in the fall, averaging 254 ± 45 targets per kilometer per hour. The mean altitude of flight was 422 m ± 54 m (1,384 feet ± 177 feet) above ground level with nightly means averaging between 172 m ± 37 m (564 ± 121 feet) and 831 m ± 23 m (2,726 feet ± 75 feet) above ground level. The percent of migrants flying within 120 m (394 feet) of the ground was 11% for the entire spring season but varied from night to night between 0 and 47%. The mean migration direction was to the northeast toward 40° ± 66°.

During both seasons, the migration measured at night was consistent with broad-front migration at relatively high altitudes. A large majority of birds flew above the rotor-swept zone, demonstrating limited avian risk.

A comparison of the dynamics of night migration at Marble River with other sites around New York State studied with radar suggests that the site is not a migration hotspot or on a hypothesized migration corridor. Table 4.2.2-1 summarizes the results from several other radar studies showing that the mean traffic rate is within the ranges reported for other states. The means of 254 for fall and 152 for spring are nearly at the middle of the rates reported. Migration direction was also similar to direction found in other sites studied. The fall direction of 193° was only 7 degrees different from the average (186°) of all eight sites for which fall migration direction has been reported. For spring, the mean direction at Marble Ridge was 16° to the north of the mean direction (24°) for the five sites for which mean directions are now available. For both seasons, there was a great degree of overlap in migration directions. With respect to altitude, the Marble River site is also within the range of other reporting locations. (It should be noted that for sites studied with radar before 2000, vertical radars were somewhat different and apparently could not detect high flying birds (B. Cooper, personal communication). So, sites

including Copenhagen, Cape Vincent, Harrisburg, Wethersfield, and Flat Rock, radar measurements of altitude are misleading. The radars used for horizontal observations for measuring direction of flight and numbers of targets aloft are identical before and after 2000.

The similarities between radar studies in sites separated by hundreds of miles within New York State strongly suggest that migration behavior and distribution is very similar throughout the state. Interestingly, there are also few differences among the New York State sites and sites in Pennsylvania, Maryland, and West Virginia (Kerlinger 1995) with respect to numbers of migrants aloft, direction of flight, and height of migration. This suggests that risk of colliding with wind turbines by night migrants is very similar throughout the northeastern United States.

Table 4.2.1-1. Summary of spring and fall migration characteristics at the Marble River Wind Project, Clinton County, New York, and several other sites in New York State

Data are from radar studies conducted by Woodlot Alternatives and ABR, Inc. – see below for citations.

Site	Targets Per Kilometer Per Hour	Mean Altitude of Flight	Percent Targets Lower than ~125 m	Mean Direction of Flight
Spring				
Marble River	254	422 m – 1,384 feet	11%	40°
Cape Vincent	473	130 m – 426 feet	65%	18°
Chautauqua	395	528 m – 1,732 feet	4%	29°
Copenhagen	280	~136 m – 446 feet	62%	12°
Wethersfield	42	178 m – 584 feet	59%	21°
Fall				
Marble River	152	438 m – 1,437 feet	5%	193°
Chautauqua	238	532 m – 1,745 feet	4%	199°
Copenhagen	371	148 m – 485 feet	49%	184°
Flat Rock	158	415 m – 1,361 feet	8%	184°
Harrisburg	135	182 m – 597 feet	45%	181°
Martinsburg	661	154 m – 505 feet	47%	191°
Prattsburgh	200	365 m – 1,197 feet	9%	177°
Wethersfield	175	154 m – 505 feet	57%	179°

For references: Marble River – Woodlot Alternatives 2005a, 2005b; Cape Vincent, Copenhagen, Martinsburg - Cooper, Johnson, and Ritchie 1995; Prattsburgh, NY – Mabee, Plissner, and Cooper 2005; Wethersfield and Harrisburg, New York - Cooper and Mabee 1999; and Chautauqua, New York – Cooper, Mabee, and Plissner 2004, Cooper, Stickney, and Mabee 2004.

4.2.2 Hawk Migration

Hawk migration throughout New York State has been well documented (including by this report's senior author, 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 the 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 hawkwatch.org, a database on hawk numbers. Overall, at the significant sites, migrating hawks can reliably be seen in impressive numbers of up to ten 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, northern Clinton County 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 Marble River Project site is the Derby Hill hawk watch. 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. Derby Hill is about 150 miles (240 km) southwest of the proposed Project.

In Quebec, two hawk watches located along the St. Lawrence River over 20 miles (32 km) northwest of the Project site report results to hawkwatch.org. The Montreal West Island Hawk Watch is a fall hawk watch recording on the order of 5,000 raptors per season. The Eagle Crossing Hawk Watch is a spring hawk watch recording on the order of 3,500 raptors per season.

Woodlot (2005) conducted a fall and spring field survey in 2005 of raptor migration over the Project site. This survey included 10 days of visual observation between September 6 and November 2, 2005 and 10 days in spring between April 5 and May 6, 2005. A total of 217 raptors of 15 species were observed in fall. Approximately 69% of the raptors were observed flying less than 120 m (400 feet) above the ground. The overall passage rate was 3.6 birds/hour. Daily count totals ranged from 6 to 76 birds. The total included two Golden Eagles and two Bald Eagles, along with very few Osprey and two Peregrine Falcons. Woodlot concluded that

passage rates at this site were low when compared with other regional sites during the same time frame. This is the case when compared with the Canadian sites mentioned above.

A total of 170 individuals of 11 species was observed in spring between April 5 and May 6, 2005. A total of 60 hours of field observations were made, averaging about 6 hours per day. This represents a passage rate of 2.8 birds per hour, including one Golden Eagle and no Bald Eagles, although two Ospreys were observed. About three-quarters of all raptors (76%) were observed flying below about 120 m, the height to the tip of the turbine rotors when in the 12 o'clock position.

Comparing the numbers of hawks and the rate of hawks per hour observed at the Marble River site with well known hawk migration sites in New York and Pennsylvania shows massive differences between these sites (Table 4.2.2-1). It is likely that the rates observed at the Marble River site are what can be found at random sites throughout the eastern United States. The comparison of hawk migration at Marble River, compared to Hawk Mountain and Little Gap, Pennsylvania for fall migration and Derby Hill and Braddock Bay, New York for spring migration show that the Project site experiences migration rates that are an order of magnitude smaller than the significant sites listed in Table 4.2.2-1. For example, the fall rate of 3.6 hawks per hour is only about 16-20% of the rate for Hawk Mountain and Little Gap, Pennsylvania. These sites are on long linear ridges that are known to concentrate hawks when oriented in the correct direction. The spring rate at Marble River of 2.8 hawks per hour (Table 4.2.2-1) is only about 5% the rate at Derby Hill and about 4% the rate for Braddock Bay. It is clear that the Marble River site does not support a significant hawk migration, although migrants can be seen flying over the site.

In general, hawk migration above the Project site can be expected to be broad front in nature, with no lakeshores or ridgelines to concentrate traffic. While the Woodlot study found most of the raptors flying below the upper limit of the sweep of the wind turbine rotors, other studies have shown hawk migration altitudes ranging 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).

Table 4.2.2-1. Comparison of results of spring and fall 2005 hawk migration count studies at Marble River Wind project site, Clinton County, New York, with data from well known hawk migration sites in Pennsylvania and New York State

Data from 2005 from www.hawkcount.org

Site	Season	Numbers of Hawks Counted	Hawks Per Hour
Marble River, NY	Spring	170	2.8
	Fall	217	3.6
Hawk Mountain, PA	Fall	~18,300	16
Little Gap, PA	Fall	~15,800	28
Derby Hill, NY	Spring	~23,600	60
Braddock Bay, NY	Fall	~30,800	66

4.2.3 Waterbird Migration

In the Project vicinity, there are no large lakes, marshes, mudflats, or other types of ecological magnets that attract waterbirds, including ducks, rails, shorebirds, and the like in significant numbers. This suggests that these types of birds would not congregate on or over the Project site during migration. Bellrose (1976) reports little in the way of waterfowl migration over northernmost New York State. This indicates that the region is not an important migratory corridor or stopover area for geese or ducks.

The site visit documented beaver ponds, several larger man-made ponds, streams, wet meadows with grasses and sedges, cattail marshes, and some very extensive bogs with alders and shrubby willows within the Project limits. An examination of topographic maps shows Lower Chateaugay Lake about 2 miles (3.2 km) southwest of the Ellenburg section. Farther to the south, as one ascends into Adirondack Park, a number of medium-size lakes can be found. But, none of these nearby water bodies is large enough or productive enough to attract significant numbers of waterbirds during fall and, to a lesser extent, spring migration.

The Project site is about equidistant from two major water bodies for waterfowl – the St. Lawrence River and Lake Champlain. They are about 20 miles (32 km) away to the northwest and east respectively. Both are migration corridors that would funnel waterfowl away from the Project area. Lake Ontario is well documented as migration magnet where significant numbers of waterbirds gather, but it is even more distant from the Project site.

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 1976). 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 agricultural fields during fall and spring migration. This type of agricultural habitat occurs on the Project site. During the late October site visit, Snow Geese and Canada Geese were recorded in the site's farm fields.

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 many birds. The Project site is subject to strong northwest winds, low temperatures, and deep snow. Food for most 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 three 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 three CBCs considered in this report covered a total area of 531 square miles (1,358 km^2). Observer participation per count during the analysis period varied from a minimum of 8 observers to a maximum of 22.

The number of species recorded in these counts ranged from a maximum of between 57 and 69 species to a minimum of between 42 and 57 species. The coverage of the three CBC circles included significant open water habitat – the St. Lawrence River in the case of St. Timothee and Massena-Cornwall, and Lake Champlain in the case of Plattsburgh. As a result, these counts 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 CBCs examined.

Table 4.3-1. CBCs Analyzed, 1996-2005

Count Name (Code)	Center County/ Province	Distance/ Bearing from Site	Years Analyzed	Number Participants	Number Species Min/Max
St. Timothee (QCSE)	Quebec	5 mi NNW	10	8-16	42-57
Plattsburgh (NYPL)	Clinton	18 mi SE	9	16-22	49-62
Massena-Cornwall (NYMC)	St. Lawrence	36.5 mi W	9	9-17	57-69

Located closest to the Project site, and including farmland and woodland habitat, the St. Timothee CBC probably indicates the frequency of birds at the Project site and vicinity better than the other counts. In this regard, Appendix E has been prepared to demonstrate graphically what birds are most likely to occur at the Project site in winter. The frequency of birds (measured in birds per hour) was determined by dividing the total number of individuals tallied by the number of census hours invested in a given count in a given year. The table reports the range of frequencies recorded for each species during the ten-year period sampled, as well as the percent of years each species was recorded.

A total of 90 species was recorded at the St. Timothee CBC over the last ten years. Only nine species (10%) were recorded at rates of 10 or more birds per census hour in at least one year and can be considered the most common species to occur in the region covered by the CBC. They were Canada Goose, Mallard, Rock Pigeon, Mourning Dove, American Crow, European Starling, Snow Bunting, Common Redpoll, and House Sparrow. Another 15 species (17%) were recorded above one bird per census hour in at least one year and could be considered common to uncommon winter birds. These included American Black Duck, Lesser Scaup, Common Goldeneye, Common Merganser, Ring-billed Gull, Herring Gull, Blue Jay, Horned Lark (special

concern), Black-capped Chickadee, American Tree Sparrow, Dark-eyed Junco, Red-winged Blackbird, Brown-headed Cowbird, House Finch, and American Goldfinch.

Sixty-five species (73%), on the other hand, were only recorded at rates below 1.0 birds per hour (more than one hour of effort required to see one bird). Of these, 36 (40% of total species) were recorded at less than 0.1 birds per hour (more than ten hours of effort required to see one bird), with most seen in two or fewer years. In other words, the majority of species recorded at the St. Timothee CBC are relatively uncommon to rare winter birds in southwest New York.

Regarding waterbirds, none are expected to occur at the Project site in the depths of winter, when aquatic or wetland habitats are frozen. Before the winter freeze, small numbers of Canada Geese, Mallard, and perhaps other species may use ponds and marshes at the Project site.

Of the ten species of diurnal raptors recorded, Red-tailed Hawk was the only species recorded above 0.1 birds per hour in most years. It would be expected to occur regularly at the Project site in winter.

Other diurnal raptors recorded at the St. Timothee CBC were Northern Harrier (threatened), Sharp-shinned Hawk (special concern), Cooper's Hawk (special concern), Northern Goshawk (special concern), Rough-legged Hawk, Merlin, Peregrine Falcon (endangered), and Short-eared Owl (endangered). Of these species, only Sharp-shinned Hawk, Cooper's Hawk, and Rough-legged Hawk were recorded most years, with only the Rough-leg occasionally recorded at higher frequencies. The Merlin and Peregrine Falcon would likely be restricted to the St. Lawrence River and would not be expected at the Project site.

Overall, the frequency of raptors at the Project site will vary from year to year depending upon snow cover and prey availability. In years with normal or heavy snow, few raptors will be present. But, if voles and mice are at the peak of their abundance fluctuations, more raptors will frequent the farm fields where wind turbines would be constructed. Raptors likely to forage in open areas around the wind turbine placements would be Northern Harrier (threatened), Red-tailed Hawk, Rough-legged Hawk, American Kestrel, and Short-eared Owl (endangered). But, based on the CBC data, the harrier and owl would be fairly infrequent, with the former recorded in 20% of the years, and the latter recorded 10%.

Open-country birds recorded in at least one year at rates above 0.1 bird per hour were Rough-legged Hawk, Horned Lark (special concern), and Snow Bunting. These birds, particularly the lark and bunting, would be the likeliest to use the farmland habitat in the vicinity of the wind turbines. During cold temperatures, high winds, or significant snow cover, their frequency would be lower.

Other winter birds that would occur in the farmland and woodland habitats that dominate the Project site would include gamebirds, doves, owls, woodpeckers, Northern Shrike, corvids, tits, nuthatches, kinglets, American Robin, European Starling, sparrows, icterids, finches, and other passerines. Generally, however, their frequencies will be relatively low, except perhaps around farmyards and residences with food and shelter.

Regarding listed species (see Table 4.3-2), the only federally listed species recorded was the threatened Bald Eagle, which has been considered for downlisting. Bald Eagle was most frequent on the Massena-Cornwall CBC, where they would congregate along the St. Lawrence River, which generally remains open in winter. Since the Project site does not front a major river that would provide open water and foraging opportunities in winter, the Bald Eagle would not be expected.

With regard to state-listed species, two endangered and four threatened species were recorded in the CBCs. Single individuals of the endangered Peregrine Falcon and Short-eared Owl were found one year each on the three CBCs, except for Massena-Cornwall in the case of the Short-eared Owl. Because the riverfront habitat the Peregrine would require in winter is not found at the Project site, it would not be expected there. In the case of the Short-ear, as discussed above, it may forage in farm country in winter, but these records indicate a low frequency and density.

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

Species (Listing[1])	CBC	Percent Years Recorded	Number Recorded per Year
Common Loon (SC)	St. Timothee	30%	1
	Plattsburgh	100%	1-20
	Massena-Cornwall	66%	1-19
Pied-billed Grebe (T)	Massena-Cornwall	22%	1
Bald Eagle (T, US-T)	Plattsburgh	33%	1-2
	Massena-Cornwall	88%	1-7
Northern Harrier (T)	St. Timothee	20%	1
	Plattsburgh	66%	1-3
	Massena-Cornwall	11%	3
Sharp-shinned Hawk (SC)	St. Timothee	50%	1-3
	Plattsburgh	66%	1-4
	Massena-Cornwall	88%	1-4
Cooper's Hawk (SC)	St. Timothee	80%	1-3
	Plattsburgh	66%	1-4
	Massena-Cornwall	66%	1-2
Northern Goshawk (SC)	St. Timothee	20%	1
	Plattsburgh	44%	1-2
	Massena-Cornwall	66%	1-2
Golden Eagle (T)	Massena-Cornwall	11%	1
Peregrine Falcon (E)	St. Timothee	40%	1
	Plattsburgh	11%	1
	Massena-Cornwall	11%	1
Short-eared Owl (E)	St. Timothee	10%	1
	Plattsburgh	11%	1
Horned Lark (SC)	St. Timothee	70%	6-136
	Plattsburgh	55%	5-120
	Massena-Cornwall	44%	2-15

[1] E = Endangered, T = Threatened, and SC = Special Concern; see Table 4.1-1.

Regarding the threatened species, Bald Eagle was discussed above. Pied-billed Grebe is unlikely, except during a warm winter when ponds and marshes remain open. But, even then, its frequency and density would be very low. Northern Harrier was well recorded on the Massena-Cornwall and Plattsburg CBCs. It may be expected to forage at the Project site in winter, but the birds that would do so would likely derive from more northern populations that are not listed. One Golden Eagle was found one year on the Massena-Cornwall CBC. A rare bird in New York State in winter, it is unlikely to occur at the Project site in winter.

Among the special-concern species, Common Loon is unlikely to occur at the Project site in winter, when breeding birds relocate to large, open water bodies. Birds of forest and forest edge, and often attracted to bird feeders around residences, the Sharp-shinned and Cooper's Hawks may use the Project sites in winter, but their numbers would be very small. Northern Goshawk may also be found on the Project site during midwinter. These birds generally eat rabbits, large rodents, and larger birds. Goshawks cover very large areas during winter in search of prey.

Of all listed species and species of concern, Horned Lark is the one that will be found most often on the Project site during winter, because it forages in farm fields. Nevertheless, in years with deep snow, Horned Larks are unlikely to be present. This is demonstrated in the significant fluctuation in numbers on the counts analyzed. Larks can be numerous, and hundreds of individuals can be present in some years. The same is true of the unlisted Snow Bunting, another open country bird.

As with the endangered and threatened species discussed above, a vast majority of the CBC records of species of special concern were likely migrants from more northerly populations that are not listed. In other words, it is unlikely that these individuals were from New York State breeding populations that are in decline.

In summary, based on the CBC analysis and what we know of the foraging habits of birds, no federal or state-listed species are likely to be found at the Project site in winter. Outside of small numbers of Canada Geese, Mallards, and perhaps other species in early winter, before a hard freeze, no waterbirds can be expected to occur at the Project site. Red-tailed Hawk would be the raptor more frequently encountered at the Project site in winter, but Northern Harrier (threatened), Sharp-shinned Hawk (special concern), Cooper's Hawk (special concern), Northern Goshawk (special concern), Rough-legged Hawk, American Kestrel, and Short-eared Owl (endangered) may also occur at lower frequencies. The likeliest birds to occur in the vicinity of the wind turbines during winter would be Horned Lark and Snow Bunting, but their frequencies would probably be less than 10 birds per hour of observation, based on the results of the nearby St. Timothee CBC.

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 any Important Bird Areas (IBA's) or federal, state, or private protected areas overlap with the Project site or are

found in close vicinity. The presence or proximity of such areas could indicate the presence of sensitive bird habitats and increased avian risk.

5.1 Important Bird Areas (IBA's)

A program of BirdLife International and Audubon, the Important Bird Area Program seeks to identify and protect essential habitats to 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.

One hundred thirty-six IBAs have been designated in New York State (Burger and Liner 2005), but none are located near the Project site. Three IBAs are located in Clinton County, but all are located along Lake Champlain. They are Chazy Landing/Kings Bay Area (#62), Plattsburgh Airfield (#63), and Valcour Island (#64). A wetland and grassland complex, the 3,800 acre Chazy Landing/King Bay Area IBA is located 22 miles (35 km) east of the Project site. Its grassland breeding bird community includes Vesper Sparrow and possibly Northern Harrier and Short-eared Owl. Twenty-six miles (42 km) southeast of the Project, the Plattsburgh Airfield IBA is considered important for grassland breeding birds, including the special-concern Horned Lark, Vesper Sparrow, and Grasshopper Sparrow. Twenty-eight miles (45 km) southeast, Valcour Island is known for its large Great Blue Heron rookery.

The two IBAs in Franklin County are Spring Pond Bog Preserve (#58) and the Adirondack Loon Complex (#59). Spring Pond is a 1,400-acre peatland complex hosting a boreal bird community typical of the higher Adirondacks. The Adirondack Loon Complex is a complex of mountain lakes that support about 80 breeding pairs of loons.

In adjacent Quebec, all of the closest IBA's are located along the St. Lawrence River and represent important habitat for waterfowl and other waterbirds. These IBA's include the Lac Saint-Francois National Wildlife Area, Canal de Beauharnois, Marais de Saint-Etienne, Marais de Saint-Timothee, and Barrage de Beauharnois. The closest of these is located about 20 miles (32 km) northwest of the Project site.

As can be seen, no IBA is located near the Project site. While the grassland habitats located along Lake Champlain are similar to those found at the Project site, the IBA-designated grasslands are of much higher quality. All the other habitats are different than those encountered at the Project site, designating important waterbird habitat or boreal habitats in the high Adirondacks.

5.2 Federal, State, and Private Protected Areas

The closest protected area to the Project is Adirondack Park, which abuts the Ellenburg section. 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.

Despite the proximity of Adirondack Park to the Project site, the park does not indicate any increased avian risk at the Project site. Adirondack Park is huge, and its primary purpose is water and forest protection. In the vicinity of the Project site, the forested habitats and associated bird communities it contains are widespread.

The Adirondack Nature Conservancy owns a protected area within 3 miles (5 km) of the Project. The Gadway Sandstone Pavement Barrens is a unique natural area where catastrophic glacial flooding about 12,000 years ago exposed sandstone bedrock. It is important for its scenic value, not for any ornithological importance. The closest wildlife management area (WMA) to the Project site is the Lewis Preserve, a 1,400-acre mainly forested area located about 10 miles (16 km) southeast.

All other protected areas are too distant from the Project site to be applicable to this avian risk assessment. Such areas include National Parks, National Forests, National Wildlife Refuges, other State Forests, State Wildlife Areas, and State Natural Areas, other TNC preserves, and Audubon sanctuaries.

Taken together, the IBAs and federal, state, county, and private protected areas in the Project region designate habitats that are not particularly well represented at the Project site. These include high-quality grasslands, waterbird habitats, boreal habitats, and extensive forest (such as contained by Adirondack Park). It appears that the Project site does not contain what might be considered essential bird habitat, nor is it distinguishable in character, habitat, or ornithological importance from the surrounding agricultural and wooded landscape.

6.0 Risk to Birds at the Proposed Marble River Wind Project

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

Presently, the best means of assessing risk to birds at prospective wind power development sites is to compare the proposed site's avifauna, geographic, and topographic settings, and habitat with empirically demonstrated levels of risk at existing sites. By comparing the types of species present or likely to be present, numbers of individuals, seasonal presence, and behavior of birds that nest, forage, migrate through, or winter on a proposed wind power site with existing facilities where risk has been determined, probabilistic assessments of risk can be made. A review of the literature on empirical studies of avian risk follows. This literature review is then used for assessing risk at the Marble River Wind Project.

Two general types of impacts have been documented at wind power projects: 1) habitat alteration and disturbance with resulting bird avoidance and displacement, and 2) fatalities

resulting from collisions with turbines, meteorology towers, and other infrastructure. These two types of impacts are detailed below.

6.1.1 Disturbance and Displacement

Habitat alteration and disturbance resulting from the construction and operation of turbines and other wind farm infrastructure sometimes can result in making a site unsuitable or less suitable for nesting, foraging, resting, or other bird use. Impacts to birds from human activity and the presence of large structures are becoming better documented. The footprint of turbine pads, roads, and other infrastructure at a project site is generally a small percentage of the site after construction. Therefore, overall land use is relatively unchanged by wind power development. But, the true amount of wildlife habitat altered by a wind power project sometimes extends beyond the actual project footprint. This results from the presence of tall structures and increased human activity. The presence of new infrastructure (primarily tall turbines) has been examined to determine whether birds avoid or are displaced from an area as a result of these new features on the landscape.

Studies documenting disturbance, avoidance, and displacement have focused mainly on birds living in grassland and other open country habitats, including farm fields. At a large wind power plant in southwestern Minnesota, reduced nesting activity was detected in grassland birds in fields close to wind turbines as opposed to farther from the turbines (Leddy et al. 1999). Leddy et al. also found that the activities of many grassland-nesting birds were inhibited within about 80 m (262 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. This study seems to be the most relevant to the Marble River project with respect to grassland nesting birds.

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.

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, giving birds ample time to habituate.

In Europe, studies have shown that some waterfowl, shorebirds, and grassland songbird species avoid the area 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 are 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). Anecdotal information from the Fenner Wind Power facility in New York State (Paul Kerlinger) suggests that Canada Geese forage in close proximity to large wind turbines. Resident geese readily habituate to human structures and activities. Thus, different species react differently to wind turbines, and it is not known if species will habituate or, if so, how long the 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) 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.

A post-construction avian study at the Searsburg, Vermont, wind power project (11 turbines on a ridgeline) may be the only study of disturbance/avoidance-type impacts to birds in a mountaintop forest (Kerlinger 2000a, 2002). 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 move away from 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.

Observations of autumn hawk migration in Vermont showed that the numbers of hawks that flew close to a hill with newly constructed turbines was smaller than in the year prior to

turbine construction and operation (Kerlinger 2000b). These migrants may have been avoiding the novel structures.

The overall results of research on bird disturbance and displacement suggest that grassland and other open country birds avoid turbines or are displaced by them to a greater degree than forest species. Forest species appear to be less averse to having tall structures or objects over their heads while foraging and nesting. It has also become evident that there are species-specific differences, with some species not being displaced as far as other species and habituating to turbines more readily. Nonetheless, which species are capable of habituating is not known, and impact gradient-type studies are needed to quantify the avoidance and displacement of various species.

6.1.2 Collision Fatalities

Avian fatalities at wind plants result from collisions with turbine rotors, guy wires of on-site meteorology towers, and, perhaps, wind turbine towers. Electrocutions occurred at older wind plants because electrical lines were above ground and constructed prior to the development of Avian Power Line Interaction Committee (APLIC) guidelines. Collision impacts have been studied at more than twenty wind power projects in nearly fifteen states in the United States (Erickson et al. 2001; see Appendix F), as well as many locations in Canada and Europe.

An estimated 28,000 to 33,000 birds were killed at about 15,000 wind turbines in the United States in 2001 (Erickson et al. 2001), yielding an average of 2.1 birds per turbine per year. Fatalities ranged from zero birds per turbine per year to upwards of about seven birds per turbine per year, the highest rate being at a site in Tennessee. Fatalities were spread among dozens of species, revealing taxonomic differences in collision susceptibility. Although this estimate is now about five years old, recent studies, especially in the Western and Midwestern United States have confirmed these fatality levels. However, studies from the Eastern United States reveal slightly higher fatality levels than farther west.

The numbers of fatalities at wind turbines annually are orders of magnitude lower than collision fatalities reported for transmission lines, windows, highways (motor vehicles), and communication towers (Erickson et al. 2001), as well as for non-collision fatalities related to cat predation, hay mowing, oil pits, fishery long lines, acid rain, etc (see www.currykerlinger.com, Hames et al. 2002). Some of these human-related mortality sources are estimated to kill tens of millions to hundreds of millions of birds per year. For perspective, turbine collision fatalities are also orders of magnitude smaller than hunting harvests determined by professional wildlife managers (data from USFWS, Martin and Johnson 2002), and lower or similar to depredation harvests permitted by the U. S. Department of Agriculture (USDA) and the USFWS. These scientifically determined harvest and "take" levels amount to more than 120 million birds per year, which is not deemed biologically significant according to various environmental assessments and impact statements.

In Europe, avian fatalities have generally been small at wind power plants, although 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 the 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 population impacts for 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 (reports on the Internet), where large numbers of raptors and other birds have reportedly been killed.

Fatalities of migrants have been relatively rare at most other sites in Europe. Perhaps the best example comes from Tarifa, Spain, where more than 100,000 raptors and other soaring birds, and millions of other birds converge on the Straits of Gibraltar to cross between Europe and Africa (Montes Marti and Barrios Jaque 1995, Janss 2000, Barrios and Rodriguez 2004, and DeLucas et al. 2004). Local Griffon Vultures and kestrels are killed on occasion, apparently because they habituate to the turbines and frequently forage amongst them. Despite large numbers of birds, fatalities of migrants at this site are rare.

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 (see Appendix F). 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 upland gamebird fatalities (three of which were alien species). The actual number of fatalities was greater (N = 24 fatalities; 0.63 fatalities per turbine per year) when searcher efficiency and carcass removal (scavenging) estimates were factored in.

At one of the world's largest wind power facilities, the State Line project in Washington and Oregon, the fatality rate per turbine per year was recently found to be slightly less than two birds per turbine per year (Erickson et al. 2002, 2003). That project has 399 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. Since some carcasses are removed by scavengers before they are found, and searcher efficiency is less than perfect, mortality studies correct for them. This is done by dividing the number of carcasses found by the scavenger-removal rate and searcher-efficiency rate (which are determined before a mortality study is initiated), resulting in a number that is usually two to three-plus times greater than the number of carcasses found.

Most of the projects in the far Western United States discussed above were situated in tilled agricultural fields or pasture/prairie-like habitats, so they are in some ways relevant to the Marble River project. 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.

Avian fatality studies also have been conducted at wind plants in the grasslands of Colorado, Wyoming, and a small site in Kansas. After five years of systematic searches at 29 new 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 included 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.

At the Foote Creek Rim project, 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). Finally, no fatalities were noted by Young (2000) at the two turbines in the Jeffrey Energy Center in Pottawatomie County, Kansas. For all of these studies, the numbers given above are the numbers of carcasses found. The actual number of fatalities is greater because, as explained above, not all carcasses are found by searchers and scavengers remove some carcasses before searchers can find them. Per turbine per year estimates based on carcass removal and searcher efficiency were made only for the Foote Creek Rim project, for which the rate was about 2.8 birds per turbine per year.

Studies done in the Eastern and Midwestern U.S. in tilled agriculture, grassland, and forest settings are most relevant to the Marble River Project, because: 1) they involve the most similar habitat, and 2) the species that either nest, forage on, or migrate through these sites are similar to those at the Marble River site. These studies have revealed relatively few avian fatalities. The Eastern projects are summarized below in Table 6.1.2-1.

Table 6.1.2-1. Mortality Study Results at Eastern U.S. Wind Projects

Project Name[1]	State[1]	Date Online[1]	# Turbines[1]	Project Capacity[1]	General Habitat	Results of Mortality Studies
Fenner	NY	2001	20	30.0 MW	Corn/Hay/Alfalfa	No study done
Madison	NY	2000	7	11.6 MW	Corn/Hay/Alfalfa	One-year study, four fatalities (two migrant songbirds, one owl, one woodpecker) (Kerlinger 2002)
Wethersfield	NY	2000	10	6.6 MW	Corn/Hay/Alfalfa	No study done
Searsburg	VT	1997	11	6.0 MW	Mountaintop Forest	Six-month study, zero fatalities (Kerlinger 2002)
Garrett	PA	2000	8	10.3 MW	Corn/Beans/Hay	12-month study, zero fatalities (Kerlinger 2001)
Meyersdale	PA	2003	20	30.0 MW	Forest	August-September 2004, few fatalities, Arnett et al. 2005
Mill Run	PA	2001	10	15.0 MW	Hay-Cow Pasture	No study done
Somerset	PA	2001	6	9.0 MW	Hay/Reclaimed Landfill	No study done
Waymart	PA	2003	43	64.5 MW	Ridgetop Forest	No study done
Mountaineer	WV	2002	44	66.0 MW	Ridgetop Forest	One-year study, 4+ fatalities per turbine including carcass removal and searcher efficiency corrections (Kerns and Kerlinger 2004); August-September 2004, few fatalities (Arnett et al. 2005)
Buffalo Mountain	TN	2000	18	29.0 MW	Ridgetop Forest/Reclaimed Strip Mine	Three-year study at three initial 660-kW turbines found ~ 7 fatalities per turbine per year (night-migrating songbirds and other species, corrected for carcass removal and searcher efficiency) (Nicholson 2001, 2002, and pers. Comm.); fifteen 1.8-MW turbines came on line in 2004

[1] From http://www.awea.org/projects/

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 six wind power facilities in the eastern United States that are in some ways relevant to the Marble River Project, involving many of the same species and migration behaviors, especially among night migrants.

Perhaps the most relevant information comes from the East are from the Madison and Fenner Wind Power Projects in Madison County, central New York State. 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 2002). 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 2 to 4-plus birds per turbine per year. Of these fatalities, most would be night migrating songbirds and similar species. At Fenner, with 20 turbines. In mid 2004, the plant manager reported no fatality events for raptors or other large birds (Paul Kerlinger, pers. comm.). Nevertheless, New York State Department of Environmental Conservation (NYSDEC) biologists 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). In southeastern Vermont, searches done in June through December 1997 (nesting through fall migration) revealed no fatalities at 11 new, unlit turbines (192 feet [58 m] tall) situated on a forested hilltop (Kerlinger 2000a and 2002).

At a facility with eight modern turbines (four with red-flashing FAA lights approximately 280 feet [85 m] tall) located in farmland in Garrett, Somerset County, southwest Pennsylvania, seventeen rounds of fatality searches conducted from June 2000 through May 2001 revealed no avian fatalities (Kerlinger 2001). A study conducted in 2003 by biologists at 44 turbines (twelve of which were lit with FAA-certified red strobes) at the Mountaineer Wind Energy Center in West Virginia found that the numbers of fatalities (about four or more birds per turbine per year, including between two and three night migrants per turbine per year, one duck, and one raptor) did not suggest significant biological impacts (Kerns and Kerlinger 2004).

The greatest fatality rate found for birds at turbines in the United States was about seven 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 2002). It is ironic that this project was lit with white strobes, the lighting recommended by the USFWS as being the least attractive (risky) to night migrants. Nonetheless, it is possible that the larger rates of fatalities at the Tennessee site are the result of the more southerly latitude of this project, as opposed to others in the eastern United States. There are more migrants at more southerly latitudes, thereby increasing potential risk to night migrants.

Regarding Midwestern projects, two years of carcass searches under 31 turbines situated in farm fields in the Kewaunee County peninsula of Wisconsin 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, Wisconsin, revealed one night migrating songbird fatality during a year-long study (Howe and Atwater 1999).

At the Buffalo Ridge wind power facility (approximately 400 turbines) near Lake Benton, Minnesota, 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 4 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 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 1976).

A study at a small wind plant in Iowa 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 and one raptor (perhaps two) were killed. Fewer than 1.5 birds per turbine per year were found to be killed at this site.

As summarized above, 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 the Midwestern and eastern United States, night migrating songbirds have accounted for a majority of the fatalities at wind turbines. 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 species.

6.2 Avian Risk Assessment for the Marble River Wind Project

6.2.1 Disturbance and Displacement Risk at the Marble River Project

At the Marble River Wind Project site, where AES and Horizon Wind Energy plan to erect wind turbines, the principal habitats are agricultural fields (hay, clover, corn, and pasture), mainly younger second-growth woodland, and mainly swampy and boggy wetlands. Given that turbines would be constructed only in upland field and woodland habitats, the development of a wind farm has the greatest potential to disturb and displace birds that nest in agricultural fields and in younger, second-growth woodlands.

Based on the Woodlot study (Woodlot 2005), the principal birds to nest in the vicinity of any wind turbines placed in field habitats would be, from higher to lower abundance, Song Sparrow, Red-winged Blackbird, American Robin, Bobolink, Savannah Sparrow, Chipping Sparrow, White-throated Sparrow, Eastern Phoebe, Horned Lark (special concern), Common Yellowthroat, Grasshopper Sparrow (special concern), and Eastern Meadowlark. Other grassland-specialty nesting birds appear to include Vesper Sparrow (special concern; probably fairly abundant) and Northern Harrier (threatened). The harrier would occur at very low density. Data indicate small likelihood that the threatened Upland Sandpiper breeds at the site, but birds may occasionally attempt to nest, originating from a healthier population in adjacent Canada, where agricultural practices appear to favor them.

Impacts to field-nesting birds are likely to include displacement of individuals nesting within 325 to 650 or more feet (100 to 200 or more meters) of the wind turbines in some cases, or reduced densities of species within 325-650 feet (100-200 m) of the turbines. Displacement would probably occur in a gradient, with fewer birds within 165-325 feet (50-100 m) from turbine bases and more nesting birds at greater distances from the turbines. Because long-term studies have not yet been conducted, it is uncertain if or how these birds will habituate to the turbines over time. Research summarized in the preceding section has shown that some birds do habituate, but long-term studies at wind power facilities have yet to be conducted. Therefore, the degree to which grassland birds habituate is not known.

The long-term significance of this disturbance and displacement cannot entirely be understood without examining the long-term integrity and maintenance of the field habitats that now compose so much of the Project site. If fields that now support grassland-nesting birds succeed into woodland in ten years, as is the case for much abandoned farmland throughout New York State, grassland birds will be displaced from those areas despite the construction of wind turbines. If the grassland-like habitats are maintained over the long-term, grassland birds can be expected to continue nesting on site. It is also not known if populations of grassland-nesting birds that are impacted by hay mowing on site are viable populations in the long-term. At a site such as Marble River, haying must kill many hundreds of nestling birds and eggs, as well as smaller numbers of adults each year. Therefore, any attempt to determine the significance of impacts to these birds from wind turbines should consider the cumulative impacts of agricultural practices, farm conversion, forest succession, and other impacts to these declining species.

With respect to birds that nest in woodland and woodland edge habitats (excluding raptors; see below), turbine construction will likely principally affect, in order of abundance, White-throated Sparrow, Black-capped Chickadee, Black-and-white Warbler, Veery, Yellow-Warbler, Black-throated Green Warbler, Rose-breasted Grosbeak, Chestnut-sided Warbler, and Common Yellowthroat (Woodlot 2005). The special-concern Golden-winged Warbler was not recorded in any of the data sets analyzed. While the special-concern Cerulean Warbler was recorded in the Woodlot study, those records are probably in error, as the habitat is not right. The special-concern Whip-poor-will may nest in low density at the Project site.

Some woodland birds may be temporarily displaced, but long-term displacement is unlikely, because woodland-dwelling birds appear to have a greater ability to habituate to tall

structures, living as they do among tall structures (trees). Kerlinger (2002) found modest disturbance to forest-dwelling songbirds at a wind power site in Vermont, but there have also been no quantitative studies on displacement distance for these types of birds, nor have there been long term studies on habituation.

Displacement impacts to nesting waterbirds at the Marble River Project site are not expected, because turbine placements will be set back from aquatic and wetland habitats. Some migrating and summering Canada Geese and migrating Snow Geese may occasionally forage for waste grain in corn fields. Canada Geese, however, often habituate quickly to human structures. Incidental observations by author Paul Kerlinger at the Fenner Wind Power Project in central New York included Canada Geese foraging in farm fields with operating turbines. In Iowa, Koford et al. (2005) have reported that Canada Geese forage in corn and soybean fields without being significantly disturbed by the presence of turbines. Nonetheless, because the agricultural fields on site may be used on occasion by some migrating waterfowl, there is a chance of temporary displacement by the presence of turbines.

With respect to raptors, minor disturbance impacts may occur if turbines are placed near nesting sites of the American Kestrel, the likeliest raptor to be encountered breeding. Other nesting raptors would be less common, including, for some reason, the Red-tailed Hawk. Certainly, Sharp-shinned Hawk (special concern), Cooper's Hawk (special concern), and Broad-winged Hawk breed in the site's woodlands. It appears likely that the threatened Northern Harrier nests in the larger fields or marshes at the Project site, but its density would be very low. At least one special-concern Osprey has attempted to nest at one of the lakes in the Clinton Section. The special-concern Northern Goshawk and Red-shouldered Hawk may also nest, but their densities would be very low.

It is likely that nesting American Kestrels and Red-tailed Hawks will habituate to the presence of turbines, especially after most construction equipment and workers have left the site. It is noteworthy that these species, plus the Northern Harrier, have been recorded to forage near (sometimes even beneath) turbines and are likely with time to habituate to the presence of turbines within their foraging areas. These and other foraging raptors have demonstrated habituation to the presence of wind turbines, as is evident from studies conducted in the APWRA (Orloff and Flannery 1992).

With regard to construction impact, some birds may be displaced from all types of habitats as heavy equipment passes through and as new roads are constructed. This impact is generally temporary and decreases markedly once construction is completed.

6.2.2 Collision Risk at the Marble River Wind Project

This section focuses on collision risk to listed species, raptors, nocturnal migrant songbirds, and waterbirds.

6.2.2.1 Listed Species

Available data demonstrate that federally listed species are unlikely to occur at the Project site, but the threatened Bald Eagle could transit the site infrequently. With respect to state-listed species, available data indicate that the threatened Northern Harrier and the special-concern American Bittern, Osprey, Sharp-shinned Hawk, Cooper's Hawk, Horned Lark, Vesper Sparrow, and Grasshopper Sparrow nest at the site. The endangered Peregrine Falcon has been recorded foraging occasionally at the Clinton section. Based on available data, it is less likely that the threatened Pied-billed Grebe, Least Bittern, Upland Sandpiper, and Sedge Wren, and the special-concern Common Loon, Northern Goshawk, Red-shouldered Hawk, Common Nighthawk, Whip-poor-will, and Golden-winged Warbler, nest at the site, but they may at very low densities (except for, perhaps, the Golden-winged Warbler, should old field habitat become ideal for it through succession).

Regarding collision threat, listed species that have aerial courtship displays, such as the threatened Northern Harrier and Upland Sandpiper and special-concern Horned Lark, could be at risk during those activities. Regularly flying in circles at 100-200 feet (30-60 m) above the ground would put these species at risk of colliding with turbine rotors (but see the discussion of the harrier in the next section). This has been documented for Horned Larks at several western wind power facilities.

6.2.2.2 Raptors

Risk to listed and unlisted raptors at the Project is not likely to be biologically significant. The numbers of fatalities will probably be small and limited primarily to American Kestrel, Red-tailed Hawk, and perhaps other species in rare instances. The species most likely to be impacted are those that forage in open country, as opposed to migrating raptors that pass through the site or general area.

The Northern Harrier (threatened) forages and probably nests on site, as was evident from the site visit, BBA data, and BBFS observations. These birds are at some risk of collision with turbines, although documented fatalities involving Northern Harriers at wind power facilities are relatively rare. Harriers occur regularly at wind power sites in the western and Midwestern United States, yet there are only a few records of collisions. The foraging flight of these birds is generally below the rotor-swept height, but their aerial displays ("sky dancing") during the nesting season may put them at rotor height and at increased risk of collision.

Based on site visit, and BBA and BBS data, Osprey (special-concern), Sharp-shinned Hawk (special concern), and Cooper's Hawk (special concern), and Broad-winged Hawk appear to use the Project sites during the breeding season. The Osprey forages over water, but it can be expected to transit the wind farm on its way to foraging sites. The other species would be expected to forage mostly within forested and forest edge areas, although Cooper's Hawks do forage at times in open country. Broad-winged Hawks are likely to soar above the forest canopy and adjacent open areas on occasion. These species will not be at particular risk of collision. The same is true of the Northern Goshawk (special concern) and Red-shouldered Hawk (special concern), which were unrecorded in the BBA or BBS.

CBC data, and inferences drawn from it, indicate that Northern Harrier (threatened), Sharp-shinned Hawk (special concern), Cooper's Hawk (special concern), Northern Goshawk (special concern), Red-tailed Hawk, Rough-legged Hawk, American Kestrel, Short-eared Owl (endangered), and Northern Shrike may hunt at the Project site in winter. Their use, however, will generally be low because of generally low prey availability and high snow cover. When rodent prey periodically peaks in abundance, some raptor species may use the site with greater frequency.

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 Marble River Project
Large concentration of turbines (about 5,400 in 2002)	~109 turbines – a large concentration by modern standards
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 flat ground and gently to moderately rolling hills
Large prey base that attracts raptors	Minimal prey base
Turbine rotors sweep to less than 10 m (30 feet) from ground	Turbine rotors sweep down to about 37 m (121 feet) above the ground
High raptor and susceptible species use of area	Moderate raptor use of area

As demonstrated in Table 6.2.2.2-1, the known or suspected risk factors for raptors are minimal at the Marble River Wind Project. That the Project will have relatively few turbines in comparison with the 5,400 that are present in the APWRA, suggests small numbers of fatalities. At the APWRA, raptor numbers are very high throughout the year, and dozens (if not hundreds) of raptors forage there, as opposed to much smaller numbers at the Marble River site.

Risk to migrating raptors should not be significant at the Marble River site, as migratory traffic above the site is low. In its study of fall migration, Woodlot (2005a, 2005b) recorded an overall passage rate of about 2.8-3.6 birds/hour in both spring and fall, which was lower than other regional raptors surveys it had access to. Surprisingly, Woodlot's observers found 69% of the raptors flying below 400 feet (120 m). Generally, hawks migrate at much higher altitudes, ranging 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). This finding of low migration altitude may be a function of using direct visual observations. Kerlinger (1989) used radar to study hawks in central New York and found that most birds were well above the altitude reported by Woodlot biologists. He also speculated that ground based counts rarely detect higher flying

birds, suggesting that such counts are biased in both numbers and in the impression they give of migration flight behavior.

There are no noteworthy hawk migration sites in the Project vicinity. Where concentrated hawk migration does occur at wind energy sites, evidence so far shows that risk to migrating raptors is not great and not likely to be biologically significant. At the Mountaineer Wind Energy Facility on Backbone Mountain (a long, linear ridge) in West Virginia, a study by Kerns and Kerlinger (2004) found that only one raptor, a Red-tailed Hawk, was killed during a year of study. Reports from Tarifa, Spain, where raptor migration is highly concentrated, strongly suggest strongly that migrating raptors rarely collide with turbines (DeLucas et al. 2004).

6.2.2.3 Nocturnal Migrants

Night migrating songbirds and other small night migrants comprise the majority of the birds killed at wind power projects, especially at Eastern and Midwestern wind farms. Nonetheless, the collision-mortality studies conducted to date (summarized in Appendix F) have not reported large or significant numbers of mortalities of night migrants. Most reports involve single birds killed by a turbine on a given night, 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, compared 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. A majority of night migrants fly at altitudes between 300 and 2,500 feet (91-915 m) above ground level (Kerlinger 1995, Kerlinger and Moore 1989), with small numbers flying above 5,000 feet (1,524 m). Except for landing and taking off, fewer migrants fly below about 500-600 feet (152-183 m) than above that height range. Mean hourly altitudes usually average about 1,200 to 1,500 feet (366-457 m) (Able 1970, Cooper et al. 2004a, 20004b). Other radar studies in the northeastern United States, including those on high ridges in Appalachia, report mean altitudes in excess of 1,200 feet (~360 m) (Kerlinger 2005, unpublished radar reports). Altitudes recorded by Bellrose (1971) were even higher than those reported by other researchers, although the use of an aircraft may have biased his measurements to higher flying birds.

Because the rotors of most modern turbines extend to about 300 to 400 feet (90 to 125 m), relatively small numbers of migrants passing over a site such as the proposed Marble River Project are likely to fly within the height range of turbine rotors. The turbines proposed for use at Marble River would be slightly taller than those situated on Appalachian ridges in West Virginia (Kerns and Kerlinger 2004) and Tennessee (Nicholson 2002). But, the turbine placements in West Virginia and Tennessee have not been demonstrated to present significant risk to night migrants.

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 much taller than the turbines proposed for the Marble River Project. The most recent literature surveys conducted by the USFWS 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 fatalities at free-standing communication towers that are as tall as 475 feet with very few exceptions (J. Gehring, 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 free-standing towers, including free-standing 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 have been demonstrated to attract migrants that then collide with the structures. The lighting on wind turbines is very different from the lighting on communication towers (FAA Advisory Circular). Wind turbines almost never have the steady-burning red lights (L-810 obstruction lights) that are present on communication towers. There is one exception – a few turbines at Buffalo Ridge in Minnesota have this lighting. Note that 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).

Research by Kerns and Kerlinger (2004) and Kerlinger (2004a, 2004b) 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. Kerns and Kerlinger (2004) did find 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. Interestingly, 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. A smaller fatality event, involving 14 migrants at two adjacent turbines in Minnesota is also of interest. Seven birds were found at each of these turbines and one was equipped with steady burning red lights. 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) has now provided the first evidence that L-810 lights are far more attractive than flashing L-864 lights. Tower fatalities studied 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 2003-4, 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 10 lights, staggered at various levels from just above the ground to more than 1,000 feet above the ground. Overall, the structure and lighting of these communication towers is very different from that of wind turbines.

As reported above, the fall radar study conducted by Woodlot Alternatives (Woodlot 2005) showed a broad-front migration pattern above the Project site at altitudes well above the rotor-sweep zone. The percent of targets observed flying below 120 m (394 feet), where collision may occur, varied by night, from 0% to 32%, with a seasonal average of 5%. A spring radar study yielded similar results, but migratory traffic was slightly higher that the 152 ± 16 targets/km/hour. These results indicate limited avian risk during migration.

For the reasons presented above, collision risk to night migrating songbirds is likely to be minimal, and fatalities are not likely to be biologically significant at the proposed Marble River Wind Project.

6.2.2.4 Waterbirds (Waterfowl, Shorebirds, Etc.)

Collision threat to nesting waterbirds should be negligible, because the numbers and diversity of nesting waterbirds will be low, and the wind turbines will be fairly well removed from their habitats. The likeliest breeders in the vicinity of the wind turbines would be Canada Goose and Mallard, which were most widely recorded in the BBA.

Regarding migration in general, risk of collision is also likely to be minimal, because most waterbirds migrate at high altitudes at night (Kerlinger and Moore 1989, Bellrose 1976). With the exception of rails, none has demonstrated a propensity to collide with wind turbines, or with communication towers. Shorebirds, for example, 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). They are also not known to be attracted to lights (FAA or other types).

In migration, there is the possibility that an occasional flock of Canada and Snow Geese may settle in the Project site's cropland to feed on waste grain. In this situation, they may

experience a slightly higher level of risk. But Canada Geese have never demonstrated susceptibility to colliding with wind turbines or with communication towers.

Winter use of the Project site by waterbirds will be negligible, as any available habitat will be frozen and fields with waste grain will be snow covered.

In any event, mortality to waterfowl at the Marble River site as a result of collisions with wind turbines will not remotely approach mortality from waterfowl hunting along the St. Lawrence River and Lake Champlain. In this regard, collision mortality will likely never rise to the level of biological significance.

7.0 Findings

The following conclusions are based on an examination of the birds, habitat, and topography present at the Marble River Wind Project and from the literature search:

1. **Land-use:** Land-use at the Project site and vicinity is about half agricultural and half forestry, but most of the valuable older trees have been removed leaving mainly a young, second-growth woodland. Land ownership is private and, given the site's relatively marginal agricultural productivity, field may be released from agriculture and allowed to succeed into woodland.

2. **Habitat Present:** The principal habitats at the Marble River Wind Project site are agricultural fields (hay, clover, corn, and pasture), mainly younger second-growth woodland, and mainly swampy and boggy wetlands.

3. **Nesting Field Birds:** Based on the Woodlot study (Woodlot 2005), the principal birds to nest in field habitats would be, from higher to lower abundance, Song Sparrow, Red-winged Blackbird, American Robin, Bobolink, Savannah Sparrow, Chipping Sparrow, White-throated Sparrow, Eastern Phoebe, Horned Lark (special concern), Common Yellowthroat, Grasshopper Sparrow (special concern), and Eastern Meadowlark. Other grassland-specialty nesting birds appear to include Vesper Sparrow (special concern; probably fairly abundant) and Northern Harrier (threatened). The harrier would occur at very low density. Data indicate small likelihood that the threatened Upland Sandpiper breeds at the site, but birds may occasionally attempt to nest, originating from a healthier population in adjacent Canada, where agricultural practices appear to favor them.

4. **Nesting Woodland Birds:** The woodland bird community at the Project site is made up largely of common species, including hawks, doves, cuckoos, owls, woodpeckers, flycatchers, vireos, corvids, swallows, tits, nuthatches, wrens, thrushes, mimids, warblers, sparrows, icterids, finches, and other species. According to the Woodlot study (2005), the principal birds to nest in woodland habitats would be, in order of abundance, White-throated Sparrow, Black-capped Chickadee, Black-and-white Warbler, Veery, Yellow-Warbler, Black-throated Green Warbler, Rose-breasted Grosbeak, Chestnut-sided Warbler, and Common Yellowthroat. The special-concern Golden-winged Warbler was not recorded in any of the databases analyzed, but it could nest in early successional woodland. The special-concern Whip-poor-will may nest at the Project site in low density.

5. **Nesting Raptors:** American Kestrel would be the likeliest raptor to be encountered nesting in the vicinity of the wind turbine placements. Other nesting raptors would be less common, including, for some reason, the Red-tailed Hawk. Data indicate that Sharp-shinned Hawk (special concern), Cooper's Hawk (special concern), and Broad-winged Hawk breed in the site's woodlands. It appears likely that the threatened Northern Harrier nests in the larger fields or marshes at the Project site, but its density would be very low. According to the site visit, at least one special-concern Osprey has attempted to nest at one of the lakes in the Clinton Section. Other potential nesting raptors would

include the special-concern Northern Goshawk and Red-shouldered Hawk, but their densities would be very low.

6. **Nesting Waterbirds:** The likeliest waterbird breeders at the Project site appear to be American Bittern (special concern), Canada Goose, Wood Duck, Mallard, Spotted Sandpiper, and Wilson's Snipe. There is also the possibility that Pied-billed Grebe (threatened), Least Bittern (threatened), and Common Loon (special concern) may nest in very low densities.

7. **Listed Nesting Birds:** As detailed in Findings 3 through 6, several New York State-listed species and species of special concern may nest on site, based on habitat present, BBA, BBS, and BBFS data, and other literature sources. Some of these species would use field habitats, and some would use woodland and wetland habitats. There is no suitable habitat on site for federally listed endangered or threatened species. Bald Eagles (federally threatened) may migrate over the site or fly through the Project area at times. BBA records indicate that the state-listed endangered Peregrine Falcon appears to forages infrequently at the Project site during the breeding season.

8. **Migratory Birds:** The nearest important waterfowl stopover sites (St. Lawrence River and Lake Champlain) are located within 20 miles (32 km) away. The wetlands present at the Project site are unlikely to attract migratory waterfowl in large numbers. While flocks of Canada and Snow Geese are likely to visit the Project site on occasion to feed on waste grain, use of the Project site by migratory waterbirds should be fairly minimal. Otherwise, waterbirds will migrate at high altitude above the wind farm, mainly at night. Hawk migration and nocturnal songbird migration can be expected to be broad-front in nature and occur at high altitude over the Project site. Migratory songbirds are likely to stopover in wooded habitats during the day to feed and rest, but concentrations of these species would be no different than at other woodland sites in northern New York.

9. **Wintering Birds:** The habitat at the Project site does not suggest large concentrations of wintering birds or the presence of federally listed species during that season. Horned Lark and Snow Bunting would be the likeliest open-country birds encountered around the wind turbine placements, but their frequencies are likely to be under 10 birds per hour in optimal conditions. The Northern Harrier and Short-eared Owl may forage at the Project site in winter, but it is likely that they would do so at low densities and frequencies, except during winters with high rodent abundances. The federally threatened Bald Eagle is known to winter regularly along the St. Lawrence, but the Project site is far from any eagle wintering roosts and lacks productive open-water habitats to attract the eagle.

10. **Important Bird Areas:** Taken together, the IBAs and federal, state, county, and private protected areas in the Project region designate habitats that are not particularly well represented at the Project site. These include high-quality grasslands, waterbird habitats, boreal habitats, and extensive forest (such as contained by Adirondack Park). It appears that the Project site does not contain what might be considered essential bird habitat, nor is it distinguishable in character, habitat, or ornithological importance from the surrounding agricultural and wooded landscape.

11. **Displacement of Grassland Birds:** Given that half or more of the wind turbines will be erected in field habitats, the Project will likely displace mainly common grassland-nesting species. But, some threatened and special-concern species may be displaced if wind turbines are placed in or adjacent to where they nest. Among listed species, the threatened Northern Harrier appears likely to nest at low density in fields or marshes at the Project site. Special-concern species likely include Horned Lark, Vesper Sparrow, and Grasshopper Sparrow. Displacement impacts are not likely to be regionally or globally significant, but they could affect local nesting populations, depending upon how many turbines are located in grassland areas. It is not known if these species habituate to the presence of turbines. Recommendations are made below to prevent and mitigate potential impacts.

12. **Displacement of Woodland Birds:** A number of wind turbines will be erected in mainly young, second-growth woodland. As a result, some woodland and woodland-edge nesting species are likely to be displaced. These will mainly be common species. Displacement impacts on woodland-nesting birds are not likely to be regionally or globally significant, but they could affect local nesting populations. Given that woodland birds are accustomed to environments with tall structures, displacement impact would be significantly less overall than with grassland birds.

13. **Displacement of Waterbirds:** No displacement of nesting waterbirds is anticipated, because the wind turbine placements will likely be far enough away from any nesting sites. Occasional flocks of Canada and Snow Geese probably stop over at the Project site to feed on waste grain. But, in Iowa, Koford et al. (2005) have reported that Canada Geese forage in corn and soybean fields without being significantly disturbed by the presence of turbines.

14. **Collision Fatality:** Fatality numbers and species impacted at the Marble River Wind Project are likely to be similar, on a per turbine per year basis, to those found at Eastern-U. S. projects that have been studied. Given that approximately 109 turbines are proposed for the site, the annual cumulative mortality will likely be greater than for smaller wind power sites in the eastern and Midwestern United States for which annual fatality numbers have been determined. As studies demonstrate, this number of fatalities, when distributed among many species, is not likely to be biologically significant. Among nesting birds, the species most likely to collide with wind turbines would be those that have aerial courtship displays, including the threatened Northern Harrier and Upland Sandpiper and special-concern Common Nighthawk and Horned Lark. But, collision risk for these species should be low to negligible, because few, if any (except for the lark), nest at the Project site. 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 low because the 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. Geese may occasionally forage in the Project site's cropland, but research in Iowa and New York indicates little susceptibility to collision with wind turbines.

8.0 Recommendations

The following recommendations for the proposed Marble River Wind Project are based on a site examination of the habitat and on searches through literature and databases 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 above-ground 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 free-standing (i.e., without guy wires) to prevent the potential for avian collisions.

- Size of roads and turbine pads should be minimized in order to disturb as little habitat as possible. After construction, any natural habitat should be permitted or encouraged to regenerate as close to the turbines and roads as possible in order to minimize habitat fragmentation and disturbance/displacement impacts.

- 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 (e.g., lay-down areas or substations) except when emergency maintenance is needed.

- A breeding bird study is recommended for spring 2006 to survey the entire Project site. It may be more valuable to locate and map specific nesting areas for threatened and special-concern species, and use this information to modify the wind farm design so as to minimize displacement impacts on these species. Success, with respect to grassland bird communities, would require a commitment by an agency, landowner, or developer to manage fields identified as high-quality grassland bird habitat. Otherwise, these fields will succeed into woodland and be lost to grassland birds. The species to focus on would be State threatened Northern Harriers, because of the higher likelihood that it nests somewhere on site. It appears unlikely that the State threatened Upland Sandpiper presently nests at the Project site, but it should be looked for. With regard to the special-concern species, their presence would help identify the highest quality field habitats, which could be set off limits to turbine placements, provided these fields can be managed to maintain their grassland bird populations. In addition, it would be useful to measure displacement impact and habituation using an impact gradient study methodology after the wind farm is constructed.

- 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 and in the Central United States.

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

This addendum addresses the recent issuance by the U.S. Fish and Wildlife Service's (USFWS) of the document, *Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines* (USFWS 2003). The Federal Register published these guidelines in early 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. The Federal Register has opened a comment period that will last two years. The guidance document has not yet been reviewed by the public or avian experts outside of the USFWS, nor has USFWS amended the document based on the significant public comment it has received over the past year. 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. In July 2005, the two-year comment period expired and the USFWS now may revise their guidance document accordingly.

It should be noted that the risk assessment conducted for the Marble River Project relied on procedures similar to those presented in the USFWS voluntary and interim guidelines, as well as other procedures that exceed what is usually requested by USFWS. For many years, the standard 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 to avoid or minimize impacts to wildlife, specifically birds and their habitats.

Specific Conformance to Guidelines

Teaming With Agencies. Letters were sent by EDR to the NYSDEC and to USFWS requesting information on listed species and species of special concern, as well as other bird information. 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 Marble River Project with respect to wildlife, although there may be state, county, or local permits required. 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 defers to USFWS with respect to wildlife issues.

Reference Sites. The Marble River Wind Project was compared to other wind power facilities in the United States, including about ten existing wind power 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 would not 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 Marble River site would be no greater than at wind power facilities in the Midwest or in the rest of the United States.

While it is not possible to compare the Marble River Project with a site that could be construed as worst-case scenario, comparisons to the APWRA where large numbers of raptor fatalities have occurred and wind power sites where risk has been documented to be negligible were made. Clearly, the Marble River 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, specifically Illinois, Wisconsin, Iowa, Minnesota, and New York.

The potential for biologically significant fatalities at wind power facilities was assessed by comparing numbers of likely fatalities at the Marble River Project with the hundred-plus millions of bird fatalities permitted by the USFWS via depredation, hunting, and falconry permits. Many of the species that are permitted to be harvested in fairly large numbers (hundreds of thousands per year) have much smaller North American populations than those species killed by wind turbines. In other cases, the species permitted to be harvested are species that have experienced steady, long-term declines, yet the harvests are not considered to be deleterious (significant) to the populations of the species. This comparison strongly suggests that impacts of wind turbines – estimated at tens of thousands of bird fatalities per year nationally – are not likely to be biologically significant. These comparisons are relevant because they provide actual numbers of takings permitted by the USFWS and various state agencies without significant impacts.

With respect to habitat disturbance and displacement of nesting birds, comparisons were made with various sites where such disturbance has been determined to occur. Some of the habitat at the Marble River Project site is already fairly degraded (cutover forests, grassland fields undergoing succession), although some of it is in fine condition. Another season of breeding bird studies was recommended to better describe the nesting bird community and identify potential nesting locations for listed species.

Alternate Sites. In the case of the Marble River 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 similar and likely to support a similar avian community. It should also be noted that if no federal permits, such as for NEPA, are necessary for this project, alternatives analysis is rarely required. The Avian Risk Assessment did, however, compare potential impacts at the Marble River Project to other wind power projects.

Checklists. Instead of using the PII and checklists supplied in the USFWS guidelines, the avian risk 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 cropland, woodland, aquatic/wetland habitats, wildlife and natural areas, degree of habitat (grassland and forest) 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 Avian Risk Assessment covers the following concerns:

- Letters of inquiry were sent to USFWS and NYSDEC requesting records of listed species.
- Habitat on site was examined to determine whether listed avian species are likely to nest or use the site.
- While located within the "Eastern Flyway," the Marble River site is not on a known, specific migration pathway for hawks, songbirds, shorebirds, waterfowl or other migrants. In addition, it has not been demonstrated that wind turbines produce biologically significant impacts to migrating birds. This avian risk assessment explains this.
- Raptor use of the area appears to be low to moderate, and topography is not steep, 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 Marble River 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 in tilled agricultural fields, because fatality numbers are small to begin with.
- Habitat fragmentation issues have been addressed in this risk assessment.
- There are no prairie grouse or similar species present at the Marble River site. Other grassland nesting species that may be disturbed or displaced have been addressed in the avian risk 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 be used at night to avoid attracting night migrants is only partially correct. Also, their recommendation 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 L-864 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 Marble River 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 migrants are suspected. A detailed discussion of the geographic and topographic patterns of migration is presented in this avian risk assessment. Despite the fact that there were no indications of large concentrations of migrants, spring and fall radar studies were conducted by Woodlot Alternatives (Woodlot 2005a, 2005b). The discussion of general patterns and the site-specific research provide strong evidence that concentrated migration does not occur at the Project site and the site is not different with respect to migration passage rate and migrant behavior to other sites in the northeastern United States. Thus, there is no scientific reason to suspect that there will be any concentration of migrants at the Project site.
- Post-construction fatality monitoring and impact gradient studies of nesting birds near turbines 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 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 done, it is difficult to determine how valuable the guidance and recommendations document is.

It should be noted that the American Wind Energy Association (AWEA) has reviewed the USFWS guidelines and recommendations. In December 2003, it submitted a detailed review to Interior Secretary Norton. AWEA requested several changes, most of which addressed the lack of scientific validation of recommendations and protocols. At this writing, discussions between the AWEA and USFWS regarding the revision of the USFWS guidelines were progressing although no date for revision of the guidance document draft has been made public.

Appendix B. Photographs of representative habitats at locations where turbines would be situated at the proposed Marble River Wind Project site in Clinton County, New York.

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Appendix C. Birds observed at and in the vicinity of the Marble River Wind Project site, Clinton County, New York, on October 31 and November 1, 2005

(Species listed by the New York State Department of Environmental Conservation [NYSDEC] are highlighted; E = Endangered, T = Threatened, SC = Special Concern; see Table 4.1-1)

Snow Goose
Canada Goose
American Black Duck
Mallard
Northern Pintail
Hooded Merganser
Northern Harrier (T)
Sharp-shinned Hawk (SC)
Red-tailed Hawk
Rough-legged Hawk
American Kestrel
Ruffed Grouse
Wild Turkey
Ring-billed Gull
Rock Pigeon
Morning Dove
Downy Woodpecker
Hairy Woodpecker
Northern Flicker
Pileated Woodpecker
Blue Jay
American Crow
Common Raven
Northern Shrike
Horned Lark (SC)
Black-capped Chickadee
Red-breasted Nuthatch
White-breasted Nuthatch
Brown Creeper
Golden-crowned Kinglet
Eastern Bluebird
American Robin
European Starling
American Pipit
Bohemian Waxwing
Cedar Waxwing
American Tree Sparrow
Savannah Sparrow
Fox Sparrow
Song Sparrow
Swamp Sparrow
White-throated Sparrow
Dark-eyed Junco
Snow Bunting
Red-winged Blackbird
Common Grackle
Purple Finch
Pine Siskin
American Goldfinch
House Sparrow

50 species

Appendix D. Birds Recorded during the 2000-2005 BBA Project

Legend: X = Possible; P = Probable; C = Confirmed

Species[1]	Block Numbers														
	5798D	5797B	5797D	5897C	5898C	5898D	5998C	5897A	5897B	5997A	5797C	5796A	5796B	5896A	All
	Main (Clinton, Figure 3)				Clinton						Ellenburg				
Pied-billed Grebe (T)											X				X
American Bittern (SC)		X			C		X			X	X				C
Great Blue Heron		X	P		X			X	P	P	X				P
Green Heron					X				X						X
Turkey Vulture		X		P	X	C	P	P	X				X	P	C
Canada Goose			P	X	C	C	C	C	P	C	P				C
Wood Duck				X	X	X	P	C				C			C
Mallard		P	X	P	P	P	P	P	P	C	P	X		P	C
Blue-winged Teal					X										X
Green-winged Teal					X										X
Hooded Merganser							X								X
Common Merganser					X										X
Osprey (SC)						X									X
Northern Harrier (T)	X	X	P	P			X	X	X						P
Sharp-shinned Hawk (SC)		X					X	X							X
Cooper's Hawk (SC)					X			X		X				X	X
Broad-winged Hawk			C		X			X			X				C
Red-tailed Hawk						P			X	X	X				P
American Kestrel	C		X	X	P	X		X	P		X			P	C
Merlin					X		X					X			X
Peregrine Falcon (E)						X	X								X
Ring-necked Pheasant			X												X
Ruffed Grouse	X	C	P			X	P			X				P	C
Wild Turkey	C		X				C	C	P	C		X		X	C
Virginia Rail	P														P
Sora							X								X
Killdeer	P	P	P	X	C	P	X		X	X	P	X	X		C

Species[1]	Block Numbers														
	5798D	5797B	5797D	5897C	5898C	5898D	5998C	5897A	5897B	5997A	5797C	5796A	5796B	5896A	All
	Main (Clinton, Figure 3)				Clinton						Ellenburg				
Spotted Sandpiper				X	X		X			C					C
Wilson's Snipe	X	P	P	X	X			X	P	X	X			X	P
American Woodcock	C				C		C							X	C
Rock Pigeon		C	C	P	X	P	P		C	P	P		P	P	C
Mourning Dove	P	P	C	P	P	X	P	P	P	P	P	P	P	P	C
Black-billed Cuckoo								X					X		X
Yellow-billed Cuckoo							C								C
Eastern Screech-Owl											X				X
Great Horned Owl	X					X									X
Barred Owl							C								C
Common Nighthawk (SC)										P					**P**
Whip-poor-will (SC)								**X**	**X**						**X**
Ruby-throated Hummingbird		X	X		X	P	C	X	P	X	X	X		P	C
Belted Kingfisher					X	X					X				X
Yellow-bellied Sapsucker		X	X	P	P	C	C	P	X	P	X	P			C
Downy Woodpecker		X	X				P	X	C	X	X				C
Hairy Woodpecker				X		X	C	X	X	P		P			C
Northern Flicker		P	P	P	P	P	P	P	X	X	P		P		P
Pileated Woodpecker		X	X	X	X		P	P							P
Olive-sided Flycatcher		X				X	P								P
Eastern Wood-Pewee		X	P	X		X	P	X	X	P	X	X			P
Yellow-bellied Flycatcher					P			X							P
Alder Flycatcher	X	P	P	P	P	C	P	C	P	P	P			X	C
Willow Flycatcher		X													X
Least Flycatcher		X	P	C	X	X	P	P	X	P	X			X	C
Eastern Phoebe	X		P		X	P	P	P	C	P	P	P	P	X	C
Great-crested Flycatcher	X	X	X	X	P	P	C	P	X	C	P				C
Eastern Kingbird	P	P	X		P	P	X	P	P	P	P	X	P	X	P
Yellow-throated Vireo						X	X			P					P
Blue-headed Vireo		P	X	P	X	P	C	X	X	P	P				C
Warbling Vireo		X	P	X	X	X	P		X	X	P			X	P
Red-eyed Vireo	X	P	P	P	C	C	P	C	C	P	X	X	P	P	C

Species[1]	Block Numbers														
	5798D	5797B	5797D	5897C	5898C	5898D	5998C	5897A	5897B	5997A	5797C	5796A	5796B	5896A	All
	Main (Clinton, Figure 3)				Clinton						Ellenburg				
Blue Jay	C	P	C	P	C	C	P	P	P	P	C	X	X	P	C
American Crow	X	P	C	C	C	P	P	P	C	P	C	X	X	P	C
Common Raven		X	P	P	X	P	P	X	X	X				X	P
Horned Lark (SC)			**X**								**C**				**C**
Purple Martin		X							X	P					P
Tree Swallow		C	C	P	C	P	P	P	C	P	C	C	P	P	C
N. Rough-winged Swallow		P													P
Bank Swallow					C				C						C
Cliff Swallow					X						X				X
Barn Swallow	P	C	C	X	C	P	P	P	C	X	C	X	P	P	C
Black-capped Chickadee	C	C	C	C	P	C	C	P	C	P	C	X	X	X	C
Tufted Titmouse														X	X
Red-breasted Nuthatch		P				X	P		C		X		P		C
White-breasted Nuthatch		P			P	X	C	X	X	X	X	P			C
Brown Creeper						P	P					X			P
House Wren		X	P		P						X				P
Winter Wren				X		C	P	X			P				C
Marsh Wren					X		X								X
Golden-crowned Kinglet		X	X		X					X	X				X
Ruby-crowned Kinglet					X									P	X
Eastern Bluebird	P	C		C	C	P	C		P	C	C	X	P	P	C
Veery	X	P	P	P	C	P	P	C	P	P	X	P	P		C
Hermit Thrush	X	C	X	P	P	C	C	C	P	P	P	P			C
Wood Thrush		P	X	X	X	P	X				X				P
American Robin		C	C	C	C	C	C	C	C	P	C	P	P	C	C
Gray Catbird	X	P	P	P	P	X	P	P	P	X	P	P	P	P	P
Brown Thrasher		X	X		X	X			P	X		C			C
European Starling	C	C	C	C	C	X	C		C	C	P	C	C	C	C
Cedar Waxwing	P	P	P	C	P	C	P	C	P	P		X	C	P	C
Tennessee Warbler						P	X								P
Nashville Warbler		C	X	X	X	P	P	P	P	P	P			X	C
Northern Parula		X													X

Species[1]	Block Numbers														
	5798D	5797B	5797D	5897C	5898C	5898D	5998C	5897A	5897B	5997A	5797C	5796A	5796B	5896A	All
	Main (Clinton, Figure 3)				Clinton						Ellenburg				
Yellow Warbler	X	P	P	X	P	P	P	P	P	P	C		P	P	C
Chestnut-sided Warbler	X	P	P	P	P	P	P	P	P	P	P	C	C	P	C
Magnolia Warbler		P	X			P	P		C		P			X	P
Black-throated Blue Warbler			P			P	P	X		P	X			X	P
Yellow-rumped Warbler		P	X	X	X	P	C			P	X			X	C
Black-throated Green Warbler		P	P	X	X	P	P		X	X	X	P		X	P
Blackburnin Warbler						P	C		X	X					C
Pine Warbler							X	P							P
Palm Warbler					X										X
Bay-breasted Warbler							X								X
Blackpoll Warbler						X									X
Black-and-white Warbler	P	P	X	P	P	P	C	P	P	X	P		X	X	C
American Redstart			X	C	X	X	P	P	P	P					C
Ovenbird	X	P	P	P	P	C	C	C	P	P	P	X	P	P	C
Northern Waterthrush		P	X			X	P	X	X	X	P				P
Mourning Warbler		X	P		P	C	P				P				P
Common Yellowthroat	P	C	P	C	P	C	P	C	P	P	C	X	P	P	C
Canada Warbler		P	P				P	X		X	C				C
Scarlet Tanager		X	X	X	P	P	C	P			X				C
Eastern Towhee		P	P								X				P
Chipping Sparrow		P	P	P	P		C	X	P	C	X	X	C	C	C
Clay-colored Sparrow					P										P
Field Sparrow			X							P	P				P
Vesper Sparrow (SC)		**P**	**P**	**C**					**X**		**P**				**C**
Savannah Sparrow	X	P	P	X	C		P		X	X	P	P	P	C	C
Grasshopper Sparrow (SC)					**X**										**X**
Song Sparrow	C	P	P	C	C	C	P	P	C	P	C	X	C	P	C
Lincoln's Sparrow		P		C			X	C			P				C
Swamp Sparrow	X	C		X	C	X	P	C	P	P	X				C
White-throated Sparrow	P	C	C	C	C	C	C	C	P	C	C	P	P	X	C
Dark-eyed Junco		P	X	X	X	P	P			X				X	P
Rose-breasted Grosbeak	X	P	P	C	P	C	C	C	X	P	X				C

Species[1]	Block Numbers														
	5798D	5797B	5797D	5897C	5898C	5898D	5998C	5897A	5897B	5997A	5797C	5796A	5796B	5896A	All
	Main (Clinton, Figure 3)				Clinton						Ellenburg				
Indigo Bunting		P	P	C	X	X	X	X	X	X	P	X			C
Bobolink		P	P	P	P	P	C		C	P	P	P	P	P	C
Red-winged Blackbird	P	C	C	C	C	X	P	P	C	C	C	C	P	P	C
Eastern Meadowlark	X	P	P	P	X				P	P	X	P	P	P	P
Common Grackle	C	C	C	P	C	C	P	C	P	P	C	C	P	C	C
Brown-headed Cowbird		X	P	P	X	X	P		P	P	X	X	P	P	P
Baltimore Oriole	X	X	P	X	X		X		X	P	X	X		X	P
Purple Finch	P	C	X	P	C	P	P	X	P	P				X	C
House Finch					X										X
American Goldfinch		P	P	P	P	X	P	P	P	P	P		P	P	P
Evening Grosbeak	P														P
House Sparrow		P	C		X				C	X	C			C	C
Total Species	**41**	**81**	**78**	**66**	**88**	**77**	**91**	**66**	**74**	**77**	**80**	**43**	**36**	**55**	**135**	
Confirmed	8	16	14	16	21	18	24	16	17	10	16	7	5	7	68	50%
Probable	13	40	38	27	27	32	47	25	32	42	31	14	24	26	37	27%
Possible	20	25	26	23	40	27	20	25	25	25	33	22	7	22	30	22%

1 E = Endangered, T = Threatened, SC = Special Concern; see Table 4.1-1

Appendix E. Frequency of Species Recorded in 1996-2005 St. Timothee (QCSE) CBC

	Birds per Hour							
Species (Listed[1])	**< 1000.0**	**< 100.0**	**< 10.0**	**< 1.0**	**< 0.1**	**> 0.1**	**% Years**	**Notes**
Snow Goose							50%	
Brant							10%	
Canada Goose							100%	
Tundra Swan							10%	
Gadwall							30%	
American Wigeon							40%	
American Black Duck							100%	
Mallard							100%	
Northern Pintail							20%	
American Green-winged Teal							10%	
Redhead							10%	
Ring-necked Duck							30%	
Greater Scaup							80%	
Lesser Scaup							80%	
Surf Scoter							10%	
White-winged Scoter							40%	
Black Scoter							10%	
Long-tailed Duck							20%	
Bufflehead							20%	
Common Goldeneye							100%	
Hooded Merganser							70%	
Common Merganser							100%	
Red-breasted Merganser							10%	
Gray Partridge							20%	
Ring-necked Pheasant							20%	
Ruffed Grouse							100%	
Wild Turkey							70%	
Common Loon (SC)							30%	
Double-crested Cormorant							80%	
Great Blue Heron							70%	
Northern Harrier (T)							20%	See Table 4.3-2

	Birds per Hour							
Species (Listed[1])	**< 1000.0**	**< 100.0**	**< 10.0**	**< 1.0**	**< 0.1**	**> 0.1**	**% Years**	**Notes**
Sharp-shinned Hawk (SC)							50%	See Table 4.3-2
Cooper's Hawk (SC)							80%	See Table 4.3-2
Northern Goshawk (SC)							20%	See Table 4.3-2
Red-tailed Hawk							100%	
Rough-legged Hawk							80%	
American Kestrel							60%	
Merlin							20%	
Peregrine Falcon (E)							40%	See Table 4.3-2
Ring-billed Gull							80%	
Herring Gull							100%	
Great Black-backed Gull							100%	
Rock Pigeon							100%	
Mourning Dove							100%	
Eastern Screech-Owl							60%	
Great Horned Owl							10%	
Snowy Owl							10%	
Short-eared Owl (E)							10%	See Table 4.3-2
Belted Kingfisher							10%	
Downy Woodpecker							100%	
Hairy Woodpecker							100%	
Northern Flicker							10%	
Pileated Woodpecker							60%	
Northern Shrike							80%	
Blue Jay							100%	
American Crow							100%	
Common Raven							40%	
Horned Lark (SC)							70%	See Table 4.3-2
Black-capped Chickadee							100%	
Tufted Titmouse							20%	
Red-breasted Nuthatch							50%	
White-breasted Nuthatch							100%	
Brown Creeper							50%	
Golden-crowned Kinglet							40%	
American Robin							60%	

	Birds per Hour							
Species (Listed[1])	**< 1000.0**	**< 100.0**	**< 10.0**	**< 1.0**	**< 0.1**	**> 0.1**	**% Years**	**Notes**
Northern Mockingbird							10%	
European Starling							100%	
Bohemian Waxwing							30%	
American Tree Sparrow							100%	
Savannah Sparrow							10%	
Song Sparrow							60%	
White-throated Sparrow							10%	
Dark-eyed Junco							100%	
Lapland Longspur							10%	
Snow Bunting							70%	
Northern Cardinal							100%	
Dickcissel							10%	
Red-winged Blackbird							40%	
Rusty Blackbird							10%	
Common Grackle							60%	
Brown-headed Cowbird							90%	
Pine Grosbeak							20%	
Purple Finch							20%	
House Finch							100%	
Common Redpoll							60%	
Pine Siskin							20%	
American Goldfinch							100%	
Evening Grosbeak							20%	
House Sparrow							100%	
90 Species								

[1] Listed species are bold-faced: E = Endangered, T = Threatened, SC = Special Concern. See Table 4.1-1.

Appendix F. REVIEW OF AVIAN MORTALITY STUDIES

The numbers provided are, in most cases, recorded fatalities. When observer efficiency and carcass removal by scavengers are factored in, the actual numbers of fatalities are greater.

Eastern States

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

- **New York** – Madison, seven modern turbines on farmland, one year, four fatalities (two migrant songbirds, one owl, and one woodpecker); Kerlinger 2002

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

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

- **Pennsylvania** – Garrett (Somerset County), eight modern turbines in farm fields, twelve months, zero fatalities; Kerlinger 2001

- **West Virginia** – Mountaineer WEC, 44 modern turbines on forested ridge, one-year study (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, one Red-tailed Hawk); Kerns and Kerlinger 2004

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

Midwest and Western Prairies

- **Wisconsin** – Kewaunee County Peninsula, 31 modern turbines in farmland, two years (four migration seasons), 25 fatalities, approx. 1.3 fatalities per turbine per year, (three waterfowl, 14 songbirds, some night migrants); Howe et al. 2002

- **Wisconsin** – Shirley, two modern turbines in farmland, 54 surveys, one fatality (night migrating songbird); report to New York Department of Natural Resources Bureau of Integrated Science Services, Richter Museum of Natural History Special Report, and Howe and Atwater 1999

- **Minnesota** – Buffalo Ridge near Lake Benton, 200+ modern turbines in farm and grassland, four years (1996-1999), 53 fatalities found, 2-4 fatalities per turbine per year (mostly

songbirds and one hawk); displacement found among grassland nesting songbirds; Johnson et al. 2002

- **Kansas** – St. Mary's, two modern turbines in grassland prairie, two migration seasons; 33 surveys, zero fatalities; Young 1999

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

- **Iowa** – Top of Iowa, 89 modern turbines (26 studied) in tilled farmland, two years, seven carcasses found, approx. one fatality per turbine per year (songbirds, two Red-tailed Hawks, no shorebirds or waterfowl); Koford et al. 2005, Iowa DNR and Iowa State University

- **Wyoming** – Foote Creek Rim, 69 modern turbines in rangeland, two years, 75 turbine fatalities (songbirds, including 48% night migrants, plus four 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 - 1999-2003, approx. two dozen birds per year, one duck, one American Kestrel fatality; Curry & Kerlinger unpublished data

Western Coastal States

- **Washington** – Nine Canyons, 37 modern turbines, prairie and farmland, one year, 36 bird fatalities found (mostly songbirds, one kestrel, one Short-eared Owl), 3.6 fatalities per turbine per year; Erickson 2003

- **Oregon-Washington** – Stateline Project, 1.5 years, 106 fatalities including seven raptors (28+ bird species total) at 124 of 399 modern turbines in farmland, 1.7 fatalities per turbine per year, 1.0 night migrant fatalities per turbine per year; Erickson et al. 2003

- **Oregon** – Klondike, 16 modern turbines in rangeland and shrub-steppe, one year, eight fatalities found (songbirds, including 50% night migrants, plus two Canada Geese), 1.3 fatalities per turbine per year; Johnson et al. 2003

- **Oregon** – Vansycle, 38 modern turbines in farm and rangeland, one year, 11 birds (seven songbirds, including about four night migrants, and four gamebirds); 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, 30-plus fatalities found (including 10 raptors, two songbirds, one duck); Howell 1997

- **California** - High Winds, 90 modern turbines in tilled farmland, one year (of three-year study), 103 carcasses found (raptors, few songbirds, few waterbirds); Report to High Winds Technical Advisory Committee

- **California** - San Gorgonio Pass Wind Resource Area, thousands of older turbines, 120 studied in desert, two years, 30 fatalities (nine waterfowl, two raptors, four songbirds, etc.); 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 grassland and scrub), two-plus years, 84 fatalities (raptors, songbirds); Orloff 1992, Anderson et al. 2000

Canada

- **Ontario** – Pickering Wind Turbine, one modern turbine near a marsh, twomigration seasons, two nocturnal migrant fatalities; James, unpublished report

- **Ontario** – Exhibition Place, one modern turbine in Toronto on the lakefront, two migration seasons, one Starling and one American Robin fatality; mortality projected at three birds per year; James and Coady 2003