Cumulative Effects Analysis

Baron Winds Project
Steuben County, New York

Prepared for:
EverPower Wind Holdings, Inc.
1251 Waterfront Place, 3rd Floor
Pittsburgh, PA 15222

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

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TABLE OF CONTENTS

List of Tables

1.0 INTRODUCTION

EverPower Wind Holdings, Inc. (EverPower) is proposing to construct and operate the Baron Winds Project (Facility) located in Steuben County, New York. The Facility, as currently planned, would have a generating capacity of up to 300 megawatts (MW). The Facility will include up to 76 commercial-scale wind turbines, access roads, underground and overhead collection lines, substation, permanent meteorological towers, staging/laydown areas, and operations and maintenance building as well as any other improvements subject to the jurisdiction of the New York State Board on Electric Generation Siting and the Environmental (Siting Board).

1.1 SCOPE OF ANALYSIS

This analysis focuses on cumulative effects associated with collision mortality of birds and bats from the proposed Facility in light of current and projected wind energy development within Steuben County and New York State. For the temporal scope, we assumed a 30-year operational life of the Facility, and the Facility will begin operating at the end of year 2020. Further we assumed EverPower will implement the following turbine operations strategy during these periods:

- [redacted]
- [redacted]

Outside of these timeframes, turbines will operate at the manufacturer's rated cut-in speed with no feathering. To inform predictions, we used mortality estimates from post-construction studies conducted in New York that are publicly available.

For decades, researchers have studied and estimated bird mortality from several sources, such as collision with man-made structures, legal hunting, and domestic cat depredation. In addition, turbines spinning or stationary in the air can pose a collision risk for birds. For bats, the emergence of wind energy development over the past decade has introduced a new source of mortality, particularly for the migratory tree-roosting bats. Post construction monitoring data, the primary source of knowledge about bat mortality, and the rapid expansion of wind development has raised concerns for the potential for substantial cumulative impacts to bats from turbine mortality. Carcasses of cave-dwelling bats are not detected as frequently as migratory tree-roosting bats. However, this mortality is adding cumulative impacts on cave-dwelling species in the wake of white-nose syndrome (WNS). In addition to mortality at wind energy facilities, this cumulative effects analysis also considers impacts associated with other mortality sources for birds and WNS for bats.

2.0 WIND ENERGY DEVELOPMENT

2.1 STEUBEN COUNTY

As of the end of June 2017, there were three existing facilities comprising 87 turbines and 196.55 MW of installed capacity operating in Steuben County. The three existing facilities are The Dutch Hill/Cohocton Wind Farm, Howard Wind Project, and Marsh Hill Wind Energy Center. EverPower plans to bring the Facility on line by the end of year 2020. In addition to the proposed Facility, there are two other facilities in advanced development in Steuben County based on review of the Siting Board's list of Article 10 submissions (NYSDPS 2017). The two other proposed facilities are the Eight Point Wind Energy Center and Canisteo Wind Energy Center. We assumed these two facilities would also come on line at the end of 2020, bringing the county's installed capacity to 889.25 MW and 284 turbines, and operate for 30 years. We also assumed that currently operating facilities would continue to operate during this same timeframe (2021-2050), i.e., the three existing facilities would be repowered rather than decommissioned. To estimate cumulative mortality of birds and bats in Steuben county, we assumed that currently operating facilities and the three proposed facilities would operate during the same 30-year timeframe.

We recognize that it is always possible that one or more of these three proposed facilities may not be constructed. Also, any of the three existing facilities could be decommissioned. Further, it is possible during the 30-year operation of the Facility there may be more than six facilities operating in Steuben County. However, our assumptions are reasonable possibilities for facilitating a cumulative effects analysis.

2.2 NEW YORK STATE

According to data compiled by the American Wind Energy Association, there were 27 existing wind facilities (20 facilities >10 MW) comprising 1,052 turbines and 1,829 MW of installed capacity operating in New York at the end of June 2017 (AWEA 2017). Growth in the wind energy sector has been rapid over the previous few years, and the U.S. Energy Information Administration's energy forecasts recently indicated a nationwide growth rate of 2.5% annually for installed wind energy capacity from 2016 through 2050 (USEIA 2017). Assuming the Facility becomes fully operational at the start of year 2021, we applied this growth rate to the current installed capacity in the state to derive estimates of wind energy development each year from 2021 through 2050 (the 30-year life of the Facility). This results in a total capacity of 2,019 MW and 1,116 turbines in 20121 and 4,131 MW and 2,376 turbines by year 2050 (average turbine capacity = 1.7 MW).

We derived an estimate of operating wind projects in New York using one method among several that could be implemented. Nonetheless, our method represents a straightforward means of estimating wind energy capacity in New York based on current policy calling for continued increase of wind energy as a total share of the electric generation in New York.

2.3 SUMMARY

Several factors would affect whether wind energy facilities are ultimately constructed and operated or repowered; these factors include energy markets, policies, regulations, and availability of incentives. We also recognize that average turbine capacity size is likely to increase, and the number of operating turbines in Steuben County and New York State may be less than our estimates. However, we believe our methodology is reasonable for estimating cumulative effects to birds and bats in the county and state. We recognize that whether wind projects are ultimately constructed and operating is likely to fluctuate due to several factors, such as policies, regulations, and energy and economic markets.

3.0 AVIAN RESOURCES

As with all wind energy facilities, we can estimate mortality, disturbance, and displacement of birds based on the construction and operation of the Facility. However, our cumulative effects analysis for birds focuses on mortality attributable to the Facility in the context of other existing and future wind facilities in Steuben County and New York State. This analysis also briefly considers other past and present anthropogenic sources of bird mortality that are likely to continue as future sources of mortality to birds during the estimated 30-year operation of the Facility.

3.1 ANTHROPOGENIC SOURCES OF AVIAN MORTALITY OTHER THAN WIND ENERGY FACILITIES

Table 1 provides estimates of anthropogenic sources of bird mortality for the U.S. in general. The national level is not our cumulative effects analysis area, but similar data for the county, New York state, or region are not readily available. The values in Table 1 are from multiple sources and some from more than a decade ago. Loss et al (2013) estimated between 140,000 and 328,000 (mean = 234,000) birds are killed annually by collisions with turbines in the contiguous U.S.

Table 1. Estimated annual avian mortality from anthropogenic causes in the U.S.

Mortality source	Estimated annual mortality	% of overall mortality
Depredation by domestic cats	1.4–3.7 billion	71-75
Collisions with buildings (including windows)	97-1,200 million	5-23
Collisions with power lines	130-174 million	3-7
Legal harvest	120 million	6
Automobiles	50-100 million	2-3
Pesticides	67-72 million	4
Communication towers	4-50 million	<1
Oil pits	1.5-2 million	<1
Wind turbines	20,000-440,000	<1
Total mortality	1.9-5.2 billion	

Sources: USFWS (2002), Erickson et al. (2005), Thogmartin et al. (2006), Dauphiné and Cooper (2009), Manville (2009), Loss et al. (2013).

3.2 MORTALITY AT THE PROPOSED FACILITY AND OTHER WIND ENERGY FACILITIES

3.2.1 Steuben County Analysis

Table 2 shows estimated numbers of bird fatalities at the Facility and wind energy facilities in Steuben County based on the mean, minimum, and maximum mortality rates reported for wind energy facilities across New York. Using results from 22 post-construction monitoring studies conducted at 12 facilities (see Appendix A, Table A-1 for the list of post-construction studies), the mean statewide bird mortality rate is 4.36 birds per turbine per year. In their Final Environmental Impact Statement, the New York State Department of Public Service (NYSDPS) acknowledged a range of estimated bird mortality rates in New York from 0.66 to 9.59 birds per turbine per year (NYSDPS 2016). Hence, our statewide rate is very close to the middle of this range.

Based on the mean statewide rate, we estimate the Facility will kill 331 birds per year (Table 2). We applied the statewide mean bird mortality rate to the estimated installed capacity of wind facilities in Steuben County in 2021, 284 turbines, to find wind energy facilities in Steuben County may kill roughly 1,238 birds annually. The Facility's contribution to this total annual mortality is 26.8%. Over its estimated 30-year operational life, the Facility is estimated to kill approximately 9,941 birds. If all six wind energy facilities in the county continue to operate consistently over 30 years, we estimate these facilities would kill around 37,000 birds (Table 2).

3.2.2 New York State Analysis

We applied the statewide average avian mortality rate of 4.36 birds per turbine per year to the estimated installed capacity of wind projects in New York in 2021, 1,116 turbines. Using the mean rate, wind energy facilities in New York will kill roughly 5,063 birds in 2021. The Facility will contribute 6.5% of this annual statewide mortality. Over its 30-year operational life, the Facility is estimated to kill approximately 9,941 birds. Using our assumptions presented above and after the Facility operates for 30 years, wind energy facilities in New York will kill roughly 222,300 birds over 30 years from 2021 through 2050. The Project's contribution will be roughly 4.5% of the total bird mortality. Table 3 provides a summary of cumulative effects of the Facility and statewide wind energy facilities.

We recognize the rates used to calculate mortality for the Facility and facilities statewide are likely to fluctuate somewhere around the mean (4.36 birds per turbine per year) from year to year. The maximum rate of 15.50 birds per turbine per year is an extraordinarily high value, and all other rates from the other 21 studies are less than 9 birds per turbine per year. We do not expect most facilities in New York, such as the proposed Facility, will experience such a high rate.

Of the bird mortality estimated to occur at the Facility, roughly 70% will be composed of birds from the passerine group. It should be noted that no one has documented that a wind energy facility has caused significant population-level impact to any one species of bird. This is largely because nocturnal migrant passerines most at risk of collision are abundant (Johnson et al. 2002, NRC 2007, Arnold and Zinc 2011). Nonetheless, below we attempt to provide context for consequences of bird mortality at the numbers estimated above for the Facility and other facilities in New York using four example species.

Table 2. Cumulative bird mortality estimates at the Baron Winds Project and current and projected installed wind energy capacity in Steuben County, New York. Mortality rates are expressed in birds per turbine per year (birds/t/y).

		Baron Winds		County-wide Facilities			
		Annual mortality	**30-year cumulative mortality**	**Annual mortality**	**Facility % contribution to annual**	**30-year cumulative mortality**	**Facility % contribution to county**
Mortality rate (birds/t/y)[1]		76 turbines	76 turbines	284 turbines[2]	76 turbines	284 turbines	76 turbines
Minimum	0.75	57	1,710	213	26.8	~6,400	26.8
Maximum	15.50	1,178	35,340	4,402	26.8	~132,100	26.8
Mean	4.36	331	9,941	1,238	26.8	~37,100	26.8

[1] Rates based on the minimum, maximum, and mean of observed mortality rates from 22 post-construction studies at 12 wind energy facilities in New York (see Appendix A, Table A-1).
[2] Estimated installed capacity based on proposed facilities in Siting Board docket for Steuben County.
Note: Values were calculated and often rounded in a spreadsheet application. Hand calculation will not necessarily result in the exact values shown in the table.

Table 3. Cumulative bird mortality estimates at the Baron Winds Project and current and projected installed wind energy capacity in New York. Mortality rates are expressed in birds per turbine per year (birds/t/y).

		Baron Winds		Statewide Facilities				
		Annual mortality	**30-year cumulative mortality**	**Annual mortality in 2021**	**Facility % contribution to annual**	**Annual mortality in 2050**	**30-year cumulative mortality**	**Facility % contribution to state**
Mortality rate (birds/t/y)[1]		76 turbines	76 turbines	1,116 turbines[2]	76 turbines	2,376 turbines[3]	1,116-2,376 turbines	76 turbines
Minimum	0.75	57	1,710	871	6.5	1,782	~38,200	4.5
Maximum	15.50	1,178	35,340	17,999	6.5	36,833	~790,200	4.5
Mean	4.36	331	9,941	5,063	6.5	10,361	~222,300	4.5

[1] Rates based on the minimum, maximum, and average of observed fatality rates from 22 post-construction studies at 12 wind energy facilities across New York (see Appendix A, Table A-1).
[2] Estimated Installed capacity based on a projected 2.5% annual growth rate (USEIA 2017) in year 2021.
[3] Estimated installed capacity based on a projected annual growth of 2.5% (USEIA 2017) from 2021 through 2050. Assumes no decommissioning of existing or new projects during the 30-year period.
Note: Values were calculated and often rounded in a spreadsheet application. Hand calculation will not necessarily result in the exact values shown in the table.

3.2.3 Individual Species Analysis

Steuben County is within Partners in Flight Bird Conservation Region Area 28, Appalachian Mountains, an area that tends to be dominated by large expanses of forest. The forests are oak-hickory and other deciduous forest types at lower elevations and softwoods of pine, hemlock, spruce, and fir in higher elevations. In Steuben County, forests are more contiguous on the ridges and highly fragmented with agriculture in the valleys.

Carcass searches during monitoring at two wind energy facilities in Steuben County found wood thrush (*Hylocichla mustelina*) and bobolink (*Dolichonyx oryzivorus*) carcasses, both considered to be Partners in Flight species of continental importance for the Appalachian Mountains region (Rosenberg et al. 2016). Red-eyed vireo (*Vireo olivaceus*) and golden-crowned kinglet (*Regulus satrapa*) are two species that are common in New York and frequently killed at New York wind energy facilities. Based on data during years 2003 through 2016 at wind energy facilities in the northeast and Ontario, post-construction monitoring found 9 wood thrushes, 41 bobolinks, 259 red-eyed vireos, and 174 golden-crowned kinglets out of the total 2,167 birds. We used these numbers to derive a proportion of total fatalities for each species.

Table 4 provides estimates of annual bird mortality and cumulative bird mortality in New York for the two important and two common bird species relative to current population estimates in New York. We used the mean mortality rate for New York facilities (4.36 birds per turbine per year) as well as the projected number of turbines (2,376) operating in the state in 2050. We estimate wind energy facilities in New York will kill roughly 10,361 birds annually. Using the mean mortality rate, wind energy facilities in New York are estimated to affect <1% of the state population of any of the 4 species annually (Table 4).

Cumulatively in 30 years, we estimate wind projects in New York will kill >222,000 birds. Based on state population estimates, <1% of red-eyed vireos and wood thrushes, and 1% of bobolinks will be affected in the 30-year period. Using the mean rate, the 30-year cumulative mortality is estimated to affect 6% of the golden-crowned kinglet population, which seems high relative to the other species listed in Table 4. The New York population of golden-crowned kinglets is estimated to make up 0.3% of the global population, and this species is not determined to be declining.

Table 4. Estimates of annual and cumulative turbine mortality in New York for years 2021 through 2050 for four species of birds that have been detected during post-construction monitoring at wind energy facilities in Steuben County. Statewide population estimates are provided for context.

Species	New York population[1]	Proportion of total fatalities[2]	Annual mortality in 2050statewide[3]	Percent of state population affected annually	Cumulative mortality from 2021-2050	Percent of state population affected cumulatively	Breeding Bird Survey trend in New York, 2005-2015[3]
Wood thrush	620,000	0.0042	43	0.007	923	0.149	Declining-significant trend
Bobolink	420,000	0.0189	196	0.047	4,205	1.001	Declining, significant trend
Red-eyed vireo	3,800,000	0.1195	1,238	0.033	26,566	0.699	Increasing, non-significant trend
Golden-crowned kinglet	300,000	0.0803	832	0.277	17,848	5.949	Increasing, non-significant trend

[1] From Partners in Flight population estimates database (PIF Science Committee 2013). These data are based on an average of Breeding Bird survey data from 1998-2007 (Blancher et al. 2013).
[2] Based on Stantec's compilation of data from post-construction monitoring studies conducted in the northeast U.S. and Ontario from 2003 through 2016. Proportions by species were calculated relative to the total number of bird carcasses reported in the studies, i.e., 2,167 birds.
[3] This value calculated using the proportion multiplied by the all-bird annual mortality. E.g., for wood thrush: 0.0042 x 1,238 = 5.20 birds.
[4] North American Breeding Bird Survey 1966-2013 Analysis (Sauer et al. 2017).
Note: Values were calculated and often rounded in a spreadsheet application. Hand calculation of the values will not necessarily result in the exact values shown in the table.

It is important to note that the most current bird population estimates reflect data that are 9 or more years old. It is possible that one or more of these species has declined or increased in recent years, and populations may change during the 30-year lifespan of the Facility. The annual and cumulative mortality estimates were applied to single population values at one place in time, and the calculations do not include other variables often used in population dynamics, such as recruitment and other sources of mortality. Despite these limitations, the results do indicate a relatively low risk for significant population declines caused by wind energy facilities in New York. Annually, wind energy facilities in 2050 would kill <1% of the most current estimated population sizes of the four species. In summary, we do not expect that wind energy facilities in New York will cause population-level effects to avian resources, even those species of conservation concern.

Our cumulative mortality estimates for New York are based on one approach to understanding cumulative effects to birds. However, this approach is conservative and uses the best available information to analyze the effect of wind energy development as one source of avian mortality among several.

3.3 SUMMARY OF CUMULATIVE EFFECTS TO AVIAN RESOURCES

Bird mortality at wind energy facilities contributes to overall mortality. Compared to other anthropogenic sources of avian mortality, the effect at wind energy facilities is minor (Table 1).

The proposed Facility is not expected to cause naturally occurring populations of common or rare birds to be reduced to numbers below levels for maintaining viability at local or regional levels (Table 4). Resulting bird mortality will contribute cumulatively to other causes of mortality, specifically other wind energy facilities and other anthropogenic sources (Table 1). Less than 1% of all anthropogenic bird mortality is attributed to wind energy facilities. Mortality at wind energy facilities in Steuben County or New York State is not likely to result in population-level impacts to any species of bird.

4.0 BAT RESOURCES

Based on the results of post-construction monitoring, the Facility has the potential to kill bats during operations. We recognize that bats will sustain these same effects at all wind energy facilities in New York. This analysis also considers the effects of WNS, which has resulted in significant bat mortality since its discovery in 2006.

4.1 MORTALITY AT THE PROPOSED FACILITY AND OTHER WIND ENERGY FACILITIES

Table 5 provides a summary of cumulative effects to bats estimated for the Facility and other existing and proposed wind energy facilities in Steuben County. Bat mortality rates vary substantially among facilities and depend on factors such as operational decisions, turbine type, and landscape characteristics. For the purposes of assessing cumulative impacts to bats at the Facility, countywide, and statewide, we used information from 19 post-construction studies conducted at 12 wind energy facilities in New York to derive a minimum, maximum, and mean bat mortality rate (Table 5; see Appendix A, Table A-1 for the list of post-construction studies). The mean mortality rate for the state is 12.36 bats per turbine per year based on normal turbine operations. Absent measures to minimize bat mortality (e.g., feathering and curtailment), the Facility could result in bat mortality of 939 bats annually and 28,181 bats over a 30-year term.

EverPower is proposing to adjust operations as described in Section 1.1. Implementing these measures, we estimate the Facility's mortality will be reduced by 50% or more, resulting in a mortality rate of 6.18 bats per turbine per year, 470 bats taken annually, and 14,090 bats taken over the 30-year term (Table 5).

4.1.1 Steuben County Analysis

To estimate cumulative effects to bats at wind energy facilities in Steuben County during the assumed 30-year operational life of the Facility, we used the mean mortality rate of 12.36 bats per turbine per year to estimate mortality at all other facilities. We assumed the mean mortality rate is applicable for existing and proposed facilities in Steuben County, other than the Baron Winds Project, and will remain constant during the 30 years from 2021 through 2050. We assumed that all other facilities would implement no feathering or curtailment strategy.

Because the Facility's all bat species combined mortality rate is conservatively estimated to be 50% the rate at the other five facilities in Steuben County, we calculated separately bat mortality for the Facility and County. Applying the statewide mean rate to 208 turbines projected to be operating by 2021 yields a mortality estimate of 2,571 bats (Table 5). Adding the Facility's mortality (470 bats per year) results in an annual mortality of 3,041 bats and a 30-year cumulative mortality of roughly 91,200 bats in Steuben County. Roughly 78% of the fatalities would be migratory tree-roosting bats (eastern red bat [*Lasiurus borealis*], hoary bat [*Lasiurus cinereus*], and silver-haired bat [*Lasionycteris noctivagans*]). This percentage has been observed at wind energy facilities throughout the eastern and Midwestern U.S.

Cumulative mortality at the proposed Facility will account for roughly 15.4% of the cumulative mortality of bats in the assumed 30 years of operation. Feathering and curtailing all turbines as described above is predicted to result in reducing mortality by 50% or more (Baerwald et al. 2009, Young et al. 2011, Stantec 2013).

To estimate cumulative effects to bats at wind energy facilities in New York during the assumed 30-year operational life of the Facility, we used the average mortality rate of 12.36 bats per turbine per year. Bat fatality rates from these projects were based on operations that implemented no feathering or curtailment. We assumed the fatality rate of 12.36 bats per turbine per year is applicable for all facilities in New York and will remain constant during the 30 years of Facility operation.

Table 5. Cumulative bat mortality estimates at the Baron Winds Project and current and projected installed wind energy capacity in Steuben County, New York. Mortality rates are expressed as bats/turbine/year (bats/t/y) and are from studies of facilities that did not employ feathering or other operational adjustments to minimize bat mortality.

Baron Winds				County-wide Facilities						
		Annual mortality	30-year cumulative mortality			Annual mortality		Facility % contribution to annual	30-year cumulative mortality	Facility % contribution to 30-year cumulative
Mortality rate (bats/t/y)[1]		76 turbines	76 turbines	Mortality rate (bats/t/y)[2]		208 turbines[3]	284 turbines[4]	76 turbines	284 turbines	76 turbines
Min	1.34	101	3,044	Min	2.67	555	657	15.4	~19,700	15.4
Max	20.02	1,522	45,646	Max	40.04	8,328	9,850	15.4	~295,500	15.4
Mean	6.18	470	14,090	Mean	12.36	2,571	3,041	15.4	~91,200	15.4

[1] Facility rates based on 50% the minimum, maximum, and mean of observed mortality rates from 19 post-construction studies at 12 wind energy facilities in New York in years 2009-2014 (post-WNS; see Appendix A, Table A-2). Implementation of operational adjustments is estimated to reduce all bat mortality by at least 50%.

[2] Rates based on the minimum, maximum, and mean of observed mortality rates from 19 post-construction studies at 12 wind energy facilities in New York in years 2009-2014 (post-WNS; see Appendix A, Table A-2).

[3] Estimated installed capacity based on proposed facilities in Siting Board docket for Steuben County minus the 76 Facility turbines. Estimated mortality is for all other Steuben County projects, which would result in the mortality rate based on no operational adjustments.

[4] Combined mortality for Facility and the other 5 facilities (3 existing and 2 proposed).

Note: Values were calculated and often rounded in a spreadsheet application. Hand calculation will not necessarily result in exact values shown in table.

Table 6. Cumulative bat mortality estimates at the Baron Winds Project and current and projected installed wind energy capacity in New York. Data are from studies of facilities that did not employ feathering or other operational adjustments to minimize bat mortality. Mortality rates are expressed as bats/turbine/year (bats/t/y).

Baron Winds				Statewide Facilities						
		Annual mortality	**30-year cumulative mortality**			**Annual mortality in 2021**	**Facility % contribution to annual**	**Annual mortality in 2050**	**30-year cumulative mortality**	**Facility % contribution to 30-year cumulative**
Mortality rate (bats/t/y)[1]		76 turbines	76 turbines	Mortality rate (bats/t/y)[2]		1,116 turbines[3]	76 turbines	2,376 turbines[4]	1,116-2,376 turbines	76 turbines
Minimum	1.34	101	3,044	Minimum	2.67	3,100	3.27	1,587	~136,100	2.24
Maximum	20.02	1,522	45,646	Maximum	40.04	46,495	3.27	90,782	~2.04 million	2.24
Mean	6.18	470	14,090	Mean	12.36	14,353	3.27	24,373	~630,100	2.24

[1] Rates based on half the minimum, maximum, and average of observed fatality rates from 19 post-construction studies at 12 wind energy facilities across New York in years 2009-2014 (post-WNS). Implementation of operational adjustment is estimated to reduce all bat mortality by at least 50%.

[2] Rates based on minimum, maximum, and average of observed fatality rates from wind energy facilities across New York in years 2007-2015 (post-WNS). Assumes all projects other than facility do not implement operational adjustments.

[3] Estimated Installed capacity based on a projected 2.5% annual growth rate (USEIA 2017) in year 2021.

[4] Estimated installed capacity based on a projected annual growth of 2.5% (USEIA 2017) from 2021 through 2050. Assumes no decommissioning of existing or new projects during the 30-year period.

Note: Values were calculated and often rounded in a spreadsheet application. Hand calculation will not necessarily result in the exact values shown in the table.

Applying this rate to the 1,116 turbines projected to be installed in New York in 2021 yields an annual mortality estimate of 14,353 bats (Table 6). Applying this rate to the projected installed capacity of 2,376 turbines in year 2050 results in an annual mortality of 24,373 bats and a cumulative total of ~630,000 bats taken during this 30-year period, of which ~490,000 will be migratory tree-roosting bats. Applying the highest rate observed at wind energy facilities in New York (40.04 bats per turbine per year), fatalities would more than triple (Table 6). However, this rate is extraordinarily high, and we do not anticipate that bat mortality rates would typically be this high at all facilities. Of the 19 post-construction studies we reviewed, 4 projects (21%) were in the range of 20-27 bats per turbine per year. Twelve of the studies (63%) reported rates <10 bats per turbine per year. We have assumed that the rate of 12.36 bats per turbine per year is an appropriate mean rate for the state. Also, the statewide fatality rate for bats is likely to become less as the implementation of operational adjustments is becoming more common, which would significantly reduce bat mortality in New York.

Cumulative mortality at the proposed Facility will account for roughly 2.24% of the cumulative statewide mortality of bats in the assumed 30 years of operation. Bat mortality at the Facility is not expected to be a significant addition to the cumulative bat mortality at wind energy facilities in New York, particularly with implementation of operational adjustments. Feathering and curtailing all turbines as described in Section 1.1 is predicted to result in reducing mortality by 50% or more (Baerwald et al. 2009, Young et al. 2011, Stantec 2013).

Each wind energy facility will contribute to bat mortality, and each facility's contribution will be proportional to the number of turbines, but mortality rates would be lower if a facility implements turbine operational adjustments. The proposed Facility will contribute a much lower percentage to the cumulative value than it would if it were to operate with no minimization measures. Nonetheless, we cannot effectively assess the effect of >91,000 bat fatalities (countywide) or >630,000 bat fatalities (statewide) over 30 years. Currently, population-level impacts are not possible as no baseline population estimates exist for any species of bat at the county level. No state-level population estimates are available for the migratory tree-roosting bat species, the species group most susceptible to wind turbine mortality. Nonetheless, operational adjustments implemented at the Baron Winds Project will have a substantial effect on reducing cumulative mortality of bats in Steuben County and New York State.

4.1.2 Northern Long-eared Bats

Since the discovery of WNS, post-construction monitoring results in New York reported 7 northern long-eared bat fatalities, which occurred at two wind energy facilities, one of which occurred in Steuben County. Any wind energy facility within the species' range has the potential to take northern long-eared bats, particularly during the fall migratory season. Arnett and Baerwald (2013) estimate 0.01% for the proportion of northern long-eared bat fatalities to all bat fatalities, and the U.S. Fish and Wildlife Service (USFWS) estimated a 0.09% proportion (USFWS 2016). We do not anticipate the Facility will take northern long-eared bats, given the proposed operational strategy. Nevertheless, if the Facility were to result in take of northern long-eared bats, we would not expect that the proportion of northern long-eared bat fatalities would exceed either of these estimated proportions.

Because of the 7 fatalities in New York, our calculated proportion of northern long-eared bat mortality to all bat mortality is much higher, 0.17%, as compared to 0.01% or 0.09%. The Facility would operate with curtailment reducing its all-bat mortality rate and thus further reduce its likelihood of taking northern long-eared bats. This is particularly relevant as no northern long-eared bat mortality has been reported for any project that implemented feathering or curtailment.

Based on the number of northern long-eared bat fatalities reported to date, we conclude that cumulative mortality at the Facility and all other wind facilities in Steuben County is not likely to lead to population-level declines in northern long-eared bats. The USFWS estimates there are 228,480 northern long-eared bats in New York (USFWS 2016). Additionally, the USFWS estimated anticipated future impacts to northern long-eared bats from collision with wind turbines throughout its range (USFWS 2016). The USFWS's analysis estimated the number of northern long-eared bat fatalities in the absence of any operational adjustments. Based on the relatively small numbers affected annually compared to the state population sizes, the USFWS did not find that the operation of wind energy facilities would result in population declines of northern long-eared bats rangewide or in any state (USFWS 2016).

4.2 WHITE-NOSE SYNDROME

WNS has emerged as the largest single source of mortality for cave-hibernating bats in recent years. As of March 2016, WNS has been confirmed in 31 states and 5 Canadian provinces and as far west as King County, Washington (WDFW 2016, USFWS 2017a). In 2012, the USFWS indicated the disease has killed more than 5.5 million bats in the U.S and Canada since its discovery in 2006 (USFWS 2012). Turner et al. (2011) documented an 88% decline in overall numbers of hibernating bats comparing pre- and post-WNS counts at 42 sites in 5 northeastern states. At these sites, northern long-eared bats decreased by 98%, little brown bats by 91%, tri-colored bats by 75%, Indiana bats by 72%, big brown bats by 41%, and eastern small-footed bats by 12% (Turner et al. 2011). To date, causative fungus, *Pseudogymnoascus destructans*, has been found in two migratory tree-roosting bat species (eastern red bat and silver-haired bat) without confirmation of the WNS disease (USFWS 2017b).

4.3 SUMMARY OF CUMULATIVE EFFECTS TO BAT RESOURCES

We acknowledge that bat mortality at wind energy facilities contributes to overall bat mortality, and the Facility's resulting bat mortality will contribute cumulatively to other wind facility mortality. Compared to the effects of WNS, cave-dwelling bat mortality at wind energy facilities is minor. However, wind energy facilities kill more migratory tree-roosting bats than any other known documented source.

By 2050, wind facilities in Steuben County and New York State are predicted to result in >91,000 and >630,000 bat fatalities, respectively, most of these being migratory tree-roosting bats (~78%).

The effect of cumulative mortality on bat populations is highly uncertain because estimates of current population sizes are unknown for those species most susceptible to turbine collision. The Facility will contribute to bat mortality, but the Facility's rate will be at least 50% lower than those facilities that are operating with no turbine adjustments during the fall migration season.

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October 10, 2017

Appendix A

October 10, 2017

Appendix A: Table A-1. Post-construction studies used to calculate statewide mortality rate for birds to assess cumulative effects to birds at the Baron Winds Facility and in Steuben County. If multiple rates were reported in the study document (often for different search intervals), we selected the highest rate.

Project Name and Survey Year	Mortality Rate Per Turbine	Mortality Rate Per MW	Survey Period	Interval	No. Turbines	Total MW	Reference
Cohocton/Dutch Hills 2009	4.70	1.88	April 15 - November 15	daily	50	125.00	Stantec 2010. Cohocton and Dutch Hill Wind Farms year 1 post-construction monitoring report, 2009.
Cohocton/Dutch Hills 2010	2.06	0.82	July 15 – September 17	daily	50	125.00	Stantec 2011. Cohocton and Dutch Hill Wind Farms year 2 post-construction monitoring report, 2010.
Cohocton/Dutch Hills 2013	3.96	1.58	July 8 – October 15	5-day	50	125.00	Stantec 2014. Cohocton and Dutch Hill Wind Farms 2013 post-construction wildlife monitoring report.
Hardscrabble 2012	6.86	3.43	April 15 – October 15	daily	37	74.00	West 2013. 2012 post-construction study and AnaBat study, Hardscrabble Wind Project, Herkimer County, New York, April 15 – October 15, 2012
High Sheldon 2010	2.64	1.76	April 15 – November 15	daily/weekly	75	112.50	West 2011. 2010 post-construction fatality monitoring study and bat acoustic study for the High Sheldon Wind Farm, Wyoming County, New York, final report April 15 – November 15, 2010
High Sheldon 2011	2.36	1.57	April 15 – November 15	daily/weekly	75	112.50	West 2012. 2011 post-construction fatality monitoring study and bat acoustic study for the High Sheldon Wind Farm, Wyoming County, New York, final report April 15 – November 15, 2011
Howard 2012	2.59	1.26	April 15 – November 15	daily/weekly	27	55.35	West 2013. 2012 post-construction monitoring studies for the Howard Wind Project, Steuben County, New York, final report April 13 – November 16, 2012
Howard 2013	0.75	0.37	May 15 – November 15	daily/weekly	27	55.35	West 2014. 2013 post-construction monitoring studies for the Howard Wind Project, Steuben County, New York, final report May 15 – November 15, 2013

October 10, 2017

Project Name and Survey Year	Mortality Rate Per Turbine	Mortality Rate Per MW	Survey Period	Interval	No. Turbines	Total MW	Reference
Maple Ridge 2006	9.59	5.81	June 17 - November 15	daily	195	321.75	Jain et al. 2007. Annual report for the Maple Ridge Wind Power Project, post-construction bird and bat fatality study - 2006. Final report. June 25, 2007.
Maple Ridge 2007	3.87	2.34	April 30 - November 14	weekly	195	321.75	Jain et al. 2009. Annual report for the Maple Ridge Wind Power Project, post-construction bird and bat fatality study - 2007. May 6, 2009.
Maple Ridge 2008	3.42	2.07	April 15 - November 9	weekly	195	321.75	Jain et al. 2009. Annual report for the Maple Ridge Wind Power Project, post-construction bird and bat fatality study - 2008. May 14, 2009.
Noble Altona 2010	2.76	1.84	April 26 – October 15	daily/weekly	65	97.50	Jain et al. 2011. Annual report for the Noble Altona Windpark, LLC, post-construction bird and bat fatality study – 2010.
Noble Bliss 2008	4.30	2.87			65	97.50	Jain et al. 2009. Annual report for the Noble Bliss Windpark, LLC, post-construction bird and bat fatality study - 2008
Noble Bliss 2009	4.45	2.98	April 15 – November 15	daily	67	100.00	Jain et al. 2010. Annual report for the Noble Bliss Windpark, LLC, post-construction bird and bat fatality study - 2009
Noble Chateaugay 2010	2.40	1.60	April 26 – October 15	weekly	71	106.50	Jain et al. 2011. Report for the Noble Chateaugay Windpark. LLC, post-construction bird and bat fatality study - 2010
Noble Clinton 2008	3.26	2.18			67	100.00	Jain et al. 2009. Annual report for the Noble Clinton Windpark, LLC, post-construction bird and bat fatality study - 2008
Noble Clinton 2009	1.76	1.18	April 15 – November 15	daily/weekly	67	100.00	Jain et al. 2010. Annual report for the Noble Clinton Windpark, LLC, post-construction bird and bat fatality study - 2009
Noble Ellenburg 2008	2.09	1.41			54	80.00	Jain et al. 2009. Annual report for the Noble Ellenburg Windpark, LLC, post-construction bird and bat fatality study - 2008
Noble Ellenburg 2009	5.69	3.84	April 15 – November 15	daily	54	80.00	Jain et al. 2010. Annual report for the Noble Ellenburg Windpark, LLC, post-construction bird and bat fatality study - 2009

Project Name and Survey Year	Mortality Rate Per Turbine	Mortality Rate Per MW	Survey Period	Interval	No. Turbines	Total MW	Reference
Noble Wethersfield 2010	2.55	1.70	April 26 – October 15	weekly	84	126.00	Jain et al. 2011. Annual report for the Noble Wethersfield Windpark, LLC, post-construction bird and bat fatality study – 2010
Steel Winds 2012	8.46	3.38	March 10 – May 31 and July 15 – September 30; November 1 – 30	weekly and biweekly in November	14	35.00	Stantec 2013. Steel Winds I and II post-construction monitoring report, 2012
Steel Winds 2013	15.50	6.20	March 21 – May 31 and July 15 – September 30	weekly	14	35.00	Stantec 2014. Steel Winds I & II Year 2 post-construction wildlife monitoring report, 2013
Average Rates	**4.36**	**2.37**					

October 10, 2017

Appendix A: Table A-2. Post-construction studies used to calculate statewide mortality rate for bats to assess cumulative effects to bats at the Baron Winds Facility and in Steuben County. If multiple rates were reported in the study document (often for different search intervals), we selected the highest rate.

Project Name	Per Turbine	Per MW	Survey Period	Interval	No. Turbines	Total MW	Reference
Cohocton/Dutch Hills 2009	40.04	16.02	April 15 - November 15	daily	50	125.00	Stantec 2010. Cohocton and Dutch Hill Wind Farms year 1 post-construction monitoring report, 2009.
Cohocton/Dutch Hills 2010	25.62	10.25	July 15 – September 17	daily	50	125.00	Stantec 2011. Cohocton and Dutch Hill Wind Farms year 2 post-construction monitoring report, 2010.
Cohocton/Dutch Hills 2013	8.03	3.22	July 8 – October 15	5-day	50	125.00	Stantec 2014. Cohocton and Dutch Hill Wind Farms 2013 post-construction wildlife monitoring report.
Hardscrabble 2012	21.34	10.67	April 15 – October 15	daily	37	74.00	West 2013. 2012 post-construction study and AnaBat study, Hardscrabble Wind Project, Herkimer County, New York, April 15 – October 15, 2012
Hardscrabble 2013	4.40	2.20	Unknown	Unknown	37	74.00	NYSDEC testimony from Cassadaga Siting Board hearings[1]
Hardscrabble 2014	8.20	4.10	Unknown	Unknown	37	74.00	NYSDEC testimony from Cassadaga Siting Board hearings[2]
High Sheldon 2010	3.50	2.33	April 15 – November 15	daily/weekly	75	112.50	West 2011. 2010 post-construction fatality monitoring study and bat acoustic study for the High Sheldon Wind Farm, Wyoming County, New York, final report April 15 – November 15, 2010
High Sheldon 2011	2.67	1.78	April 15 – November 15	daily/weekly	75	112.50	West 2012. 2011 post-construction fatality monitoring study and bat acoustic study for the High Sheldon Wind Farm, Wyoming County, New York, final report April 15 – November 15, 2011
Howard 2012	20.09	10.00	April 15 – November 15	daily/weekly	27	55.35	West 2013. 2012 Post-Construction Monitoring Studies for the Howard Wind Project, Steuben County, New York, Final Report April 13 – November 16, 2012

[1] Information on Hardscrabble 2013 is derived from B. Denoncour and C. J. Herzog, direct testimony in the matter of the application of Cassadaga Wind LLC for a Certificate of Environmental Compatibility and Public Need pursuant to Article 10 to construct a wind energy facility. Case No.: 14-F-0490. May 12, 2017.
[2] Information on Hardscrabble 2014 is derived from B. Denoncour and C. J. Herzog, direct testimony in the matter of the application of Cassadaga Wind LLC for a Certificate of Environmental Compatibility and Public Need pursuant to Article 10 to construct a wind energy facility. Case No.: 14-F-0490. May 12, 2017.

October 10, 2017

Project Name	Per Turbine	Per MW	Survey Period	Interval	No. Turbines	Total MW	Reference
Howard 2013	4.29	2.13	May 15 – November 15	daily/weekly	27	55.35	West 2014. 2013 post-construction monitoring studies for the Howard Wind Project, Steuben County, New York, final report May 15 – November 15, 2013
Maple Ridge 2012	13.83	8.38	July 12 – October 15	weekly	195	321.75	West 2013. 2012 post-construction fatality monitoring study for the Maple Ridge Wind Farm, Lewis County, New York, final report July 12 – October 15, 2012
Noble Altona 2010	6.51	4.34	April 26 – October 15	daily/weekly	65	97.50	Jain et al. 2011. Annual report for the Noble Altona Windpark, LLC, post-construction bird and bat fatality study – 2010.
Noble Bliss 2009	8.24	5.50	April 15 – November 15	daily	67	100.00	Jain et al. 2010. Annual report for the Noble Bliss Windpark, LLC, post-construction bird and bat fatality study - 2009
Noble Chateaugay 2010	3.66	2.44	April 26 – October 15	weekly	71	106.50	Jain et al. 2011. Annual report for the Noble Chateaugay Windpark. LLC, post-construction bird and bat fatality study - 2010
Noble Clinton 2009	9.72	6.48	April 15 – November 15	daily/weekly	67	100.00	Jain et al. 2010. Annual report for the Noble Clinton Windpark, LLC, post-construction bird and bat fatality study - 2009
Noble Ellensburg 2009	8.01	5.30	April 15 – November 15	daily	54	80.00	Jain et al. 2010. Annual Report for the Noble Ellenburg Windpark, LLC, Post-construction Bird and Bat Fatality Study - 2009
Noble Wethersfield 2010	24.45	16.30	April 26 – October 15	weekly	84	126.00	Jain et al. 2011. Annual report for the Noble Wethersfield Windpark, LLC, post-construction bird and bat fatality study – 2010
Steel Winds 2012	6.88	2.75	March 10 – May 31 and July 15 – September 30; November 1 – 30	weekly and biweekly in November	14	35.00	Stantec 2013. Steel Winds I and II post-construction monitoring report, 2012
Steel Winds 2013	15.30	6.14	March 21 – May 31 and July 15 – September 30	weekly	14	35.00	Stantec 2014. Steel Winds I & II year 2 post-construction wildlife monitoring report, 2013
Average Rates	**12.36**	**6.33**					