Large Bird Use Survey Report

Emmons-Logan Wind Energy Center and 230 kV Transmission Line

Emmons and Logan Counties, North Dakota

Final Report

April 2017 – March 2018

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EXECUTIVE SUMMARY

Emmons-Logan Wind, LLC (Emmons-Logan Wind), a wholly-owned, indirect subsidiary of NextEra Energy Resources, LLC is developing the Emmons-Logan Wind Energy Center and 230 kV Transmission Line (Project), in Emmons and Logan counties, North Dakota. Emmons-Logan Wind tasked Western EcoSystems Technology, Inc. to conduct large bird use surveys in the proposed Project. This document provides results of the large bird use surveys and incidental wildlife observations conducted from 2017 – 2018, with emphasis on eagles and other diurnal raptors, and federal- and state-listed species.

The principal objectives of the study were to: 1) assess the relative abundance and spatial and temporal distribution of large birds in the Project, 2) identify and assess the potential risk of adverse impacts to large birds, particularly eagles and other raptors, and federal- and state-listed species, and 3) provide information that could be used for project planning and design of the facility to minimize impacts to large birds.

Large bird use surveys were conducted within the Project from April 4, 2017 – March 27, 2018, at 23 points. Each survey plot was a 2,625-foot (ft; 800-meter [m]) radius circle centered on the point. Fixed-point count surveys were conducted for 60 minutes (min) once per month. All large birds were recorded regardless of distance and were included in the development of species composition, relative abundance, and species diversity metrics. However, only large birds within the 2,625-ft radius plot were included in analyses of large bird use and flight heights. Incidental observations were also recorded during the one-year study in a similar fashion to standardized surveys, but were not included in analyses. Additionally, for each period of time that eagles were observed, distance from observer, activity and flight height, if applicable, were recorded on a per min basis as specified in the Eagle Conservation Plan Guidance. Eagle flight paths and perch locations were also recorded on a map.

A total of 236 hours of surveys were completed with 28 bird species identified. Diurnal raptor use was highest during the fall (0.48 birds/plot/60-min survey) compared to any other season. The most common raptor species observed within the Project area were northern harrier (*Circus cyaneus*; 22 observations in 21 groups), red-tailed hawk (*Buteo jamaicensis*; 19 observations in 19 groups), and Swainson's hawk (*Buteo swainsoni*; 15 observations in 15 groups). One bald eagle (*Haliaeetus leucocephalus*) and one golden eagle (*Aquila chrysaetos*) were observed in the winter during surveys. Mean use by bald and golden eagles was the same with 0.08 eagles/plot/60-min survey. A total of three eagle minutes were recorded during surveys, all of which were also eagle risk minutes. One bald eagle was observed for one min at Point 5 on November 13, 2017, and one golden eagle was observed for two min at Point 19 on November 14, 2017. Additionally, one bald eagle was observed incidentally. Waterfowl was the most abundant bird type observed during the one-year study conducted at the Project (14,521 observations in 29 groups), with snow goose (*Chen caerulescens*) being the most common waterfowl species observed.

Overall mean annual diurnal raptor use at the Project was 0.18 raptors/plot/20-min survey, which ranked 42nd when compared to 48 projects with publicly available data from the central and western US that implemented similar study seasons and methods.

Twenty large bird species were observed incidentally within the Project, totaling 358 observations in 78 groups. A total of 14 sensitive species, all considered North Dakota Species of Conservation Priority, were recorded during large bird use surveys and incidentally. No federally endangered, threatened, candidate, or proposed species were observed during surveys. The bald eagle and one golden eagle are both protected under the Bald and Golden Eagle Protection Act. Furthermore, the bald eagle is also a US Fish and Wildlife Service Bird of Conservation Concern; along with the chestnut-collared longspur (*Calcarius ornatus*), marbled godwit (*Limosa fedoa*), Sprague's pipit (*Anthus spragueii*), Swainson's hawk (*Buteo swainsoni*), and upland sandpiper (*Bartramia longicauda*).

STUDY PARTICIPANTS

Western EcoSystems Technology

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REPORT REFERENCE

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INTRODUCTION

Emmons-Logan Wind, LLC (Emmons-Logan Wind), a wholly-owned, indirect subsidiary of NextEra Energy Resources, LLC, is developing the Emmons-Logan Wind Energy Center and 230 kV Transmission Line (Project) in south-central North Dakota. Emmons-Logan Wind tasked Western EcoSystems Technology, Inc. (WEST) to conduct avian use surveys to estimate temporal and spatial bird use within the Project area. Studies conducted in 2017 – 2018 focused on large birds, with an emphasis on eagles and other diurnal raptors and federal and state-listed species. The methods for this study were consistent with the US Fish and Wildlife Service (USFWS) *Eagle Conservation Plan Guidance: Module 1 - Land-Based Wind Energy Guidance, Version 2* (ECPG; USFWS 2013) and *Final Land-Based Wind Energy Guidelines* (WEG; USFWS 2012).

The principal objectives of the study were to: 1) assess the relative abundance and spatial and temporal distribution of large birds in the Project area, 2) identify and assess the potential risk of adverse impacts to large birds, particularly eagles and other raptors, and federally and state-listed species, and 3) provide information that could be used for planning and design of the Project to minimize impacts to large birds. This report contains results for the avian use surveys and incidental wildlife observations conducted for the Project from April 4, 2017 – March 27, 2018.

PROJECT AREA

The Project, located in Emmons and Logan counties, North Dakota, is approximately eight miles (mi; 13 kilometers [km]) northeast of the town of Linton, North Dakota (Figure 1), encompasses approximately 75,375 acres (ac; 30,503 hectares [ha]). The Project falls within the Northwestern Glaciated and Northwestern Great Plains Level III ecoregions, characterized by semi-arid rolling plains and moderately high concentrations of seasonal wetlands; vegetation in the Project area is a mix of short-grass or mixed-grass prairie and agricultural cropland (US Environmental Protection Agency [USEPA] 2017). Trees and shrubs can be found around farmsteads, within planted shelter belts, and along/within drainages. The landscape within the Project area is flat to rolling with elevation ranging from approximately 1,916–2,175 feet (ft; (584–663 meters [m).

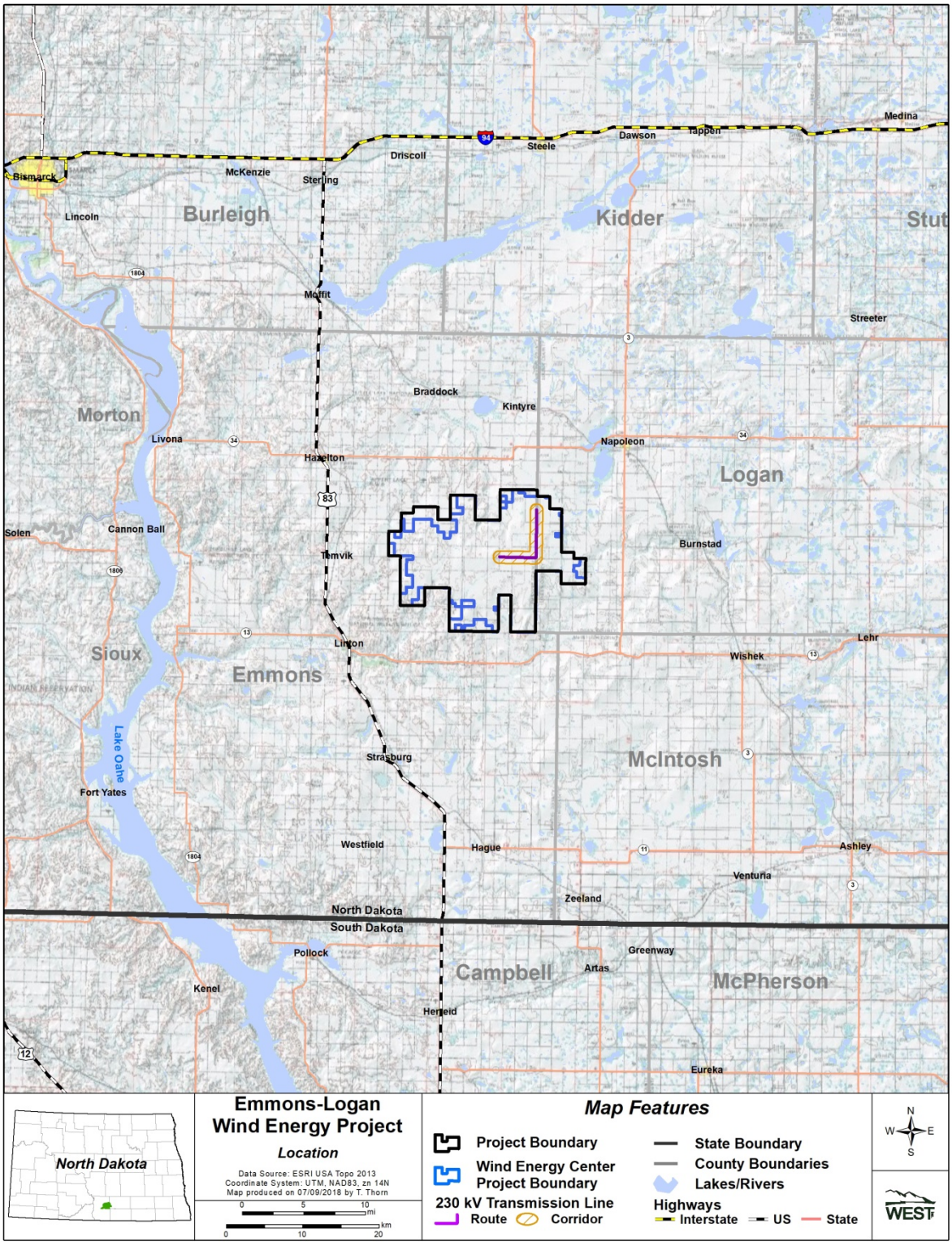

Figure 1. Location of the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan counties, North Dakota.

METHODS

Large Bird Use Surveys

Large bird use surveys (variable circular plots) were conducted using methods described by Reynolds et al. (1980). Large birds included waterbirds, waterfowl, shorebirds, rails and coots, grebes and loons, gulls and terns, diurnal raptors (defined here as accipiters, buteos, eagles, falcons, harriers, kites, and osprey [*Pandion haliaetus*]), owls, vultures, upland game birds, doves and pigeons, some cuckoos, large corvids (i.e., ravens, magpies, and crows), and goatsuckers.

Survey Plots

Twenty-three observation points consisting of 2,625-ft (800-m) radius survey plots were established to survey approximately 30% of the Project area, as described at the start of surveys in 2017, while achieving relatively even coverage of representative habitats and topography (Figure 2). Observation points were located along public roads implementing a systematic sampling scheme with a random start using ArcGIS software (Environmental Systems Research Institute, Inc. [ESRI] 2016).

Survey Methods

Each survey plot was surveyed for large birds only during the 60 minute (min) period. All large birds observed during the use survey were assigned a unique observation number. In some cases, observations represented repeated sightings of the same individual. Observations of large birds outside the 2,625-ft radius survey plot were recorded and included in the development of species composition, relative abundance, and species diversity metrics, but were not included in analyses of avian use, flight heights, or risk exposure.

The date, start and end time of the survey period, and weather information (e.g., temperature, wind speed, wind direction, and cloud cover) were recorded for each survey. Species or best possible identification, number of individuals, time of observation, sex and age class (if identifiable), distance from survey plot center when first observed, closest distance between bird and observer, flight height above ground level (AGL), activity (behavior), and habitat(s) used by birds were recorded for each observation. Approximate flight height and distance from survey plot center were recorded to the nearest 16-ft (5-m) interval. Other information recorded included whether or not the observation was auditory only and the 10-min interval of the 60-min survey in which it was first observed.

For bald (*Haliaeetus leucocephalus*) or golden (*Aquila chrysaetos*) eagle observations, flight height, distance, and activity (i.e., flying or perched) were recorded during each 1-min interval, per the ECPG (USFWS 2013). The perch locations and flight paths of eagles were mapped on the datasheets and digitized using ArcGIS software (ESRI 2016) to qualitatively assess areas of eagle use within the Project.

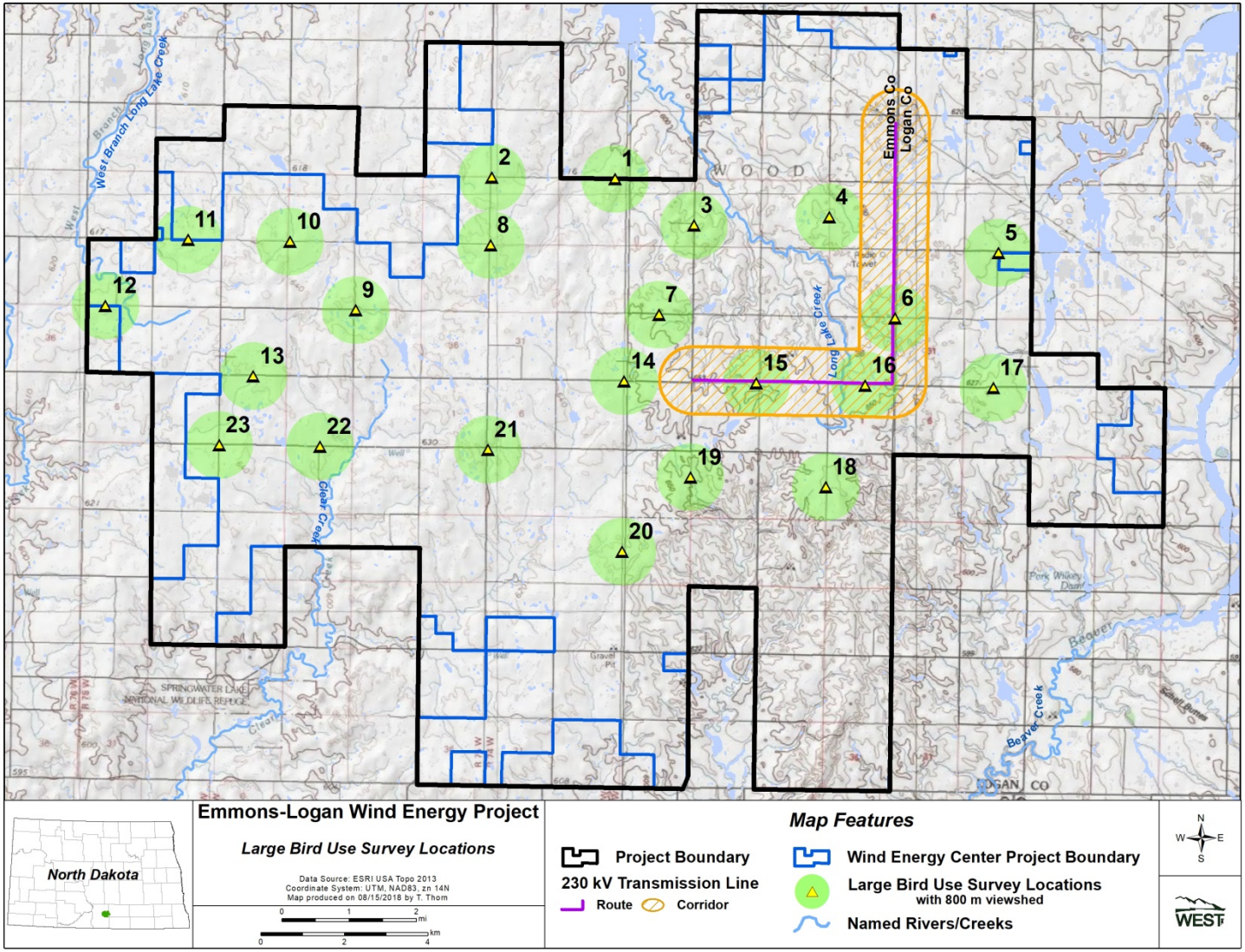

Figure 2. Location of large bird use observation points and 2,625-feet (800-meter) radius survey plots within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan counties, North Dakota.

Observation Schedule

Sampling intensity was designed to document the use of large birds within the Project area. Each survey plot was surveyed approximately once per month during all seasons: spring (March 1 – May 31), summer (June 1 – August 31), fall (September 1 – November 12), and winter (November 13 – February 28). Surveys were conducted during daylight hours and survey periods were varied to approximately cover all daylight hours during a season. To the extent practical, each survey plot was surveyed roughly the same number of times, weather and road conditions permitting.

Statistical Analysis

Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) measures were implemented at all stages of the study, including in the field, during data entry and analysis, and report writing. Following surveys, observers were responsible for inspecting data forms for completeness, accuracy, and legibility. Potentially erroneous data were identified using a series of database queries. Irregular codes or data suspected as being questionable were discussed with the observer and/or project manager. Errors, omissions, or problems identified in later stages of analysis were traced back to the raw data forms, and appropriate changes in all steps were made.

Data Compilation and Storage

A Microsoft® MSSQL Server database was developed to store, organize, and retrieve survey data. Data were keyed into the electronic database using a pre-defined protocol to facilitate subsequent QA/QC and data analysis. All data forms, field notebooks (if provided), and electronic data files were retained for reference.

Large Bird Use Surveys

For analysis purposes, a visit was defined as the required length of time, in days, to survey all of the survey plots once within the Project area. Visits were assigned according to the following criteria: 1) a single visit had to be completed in a single season, and 2) a visit could be spread across multiple dates, but a single date could not contain surveys from multiple visits. Under certain circumstances, such as extreme weather conditions, survey plots were not surveyed during some visits. In these cases, a visit might not have constituted a survey of all plots.

Bird Species Diversity and Species Richness

Species lists (with the number of groups and observations) were generated from all the birds detected during the 60-min large bird use surveys, regardless of their distance from the observer (i.e., including observations detected beyond the 2,625-ft radius survey plot). In some cases, the tally of observations may represent repeated sightings of the same individual. Bird species diversity was illustrated by the total number of species observed. Species richness was calculated by averaging the total number of species observed within each 2,625-ft radius survey plot during a visit, then averaging across survey plots within each visit, followed by averaging

across visits within the season. Overall species richness was calculated as a weighted average of seasonal values by the number of days in each season.

Bird Use, Percent of Use, and Frequency of Occurrence

For generating standardized fixed-point large bird use estimates, birds detected within the 2,625-ft radius survey plot at any time within the 60-min survey were used in the analysis. The metric used to measure mean large bird use was the number of large birds per 2,625-ft radius survey plot per 60-min survey (large birds/plot/survey). Mean use by season was calculated by summing the total number of large birds seen within each survey plot during a visit, then averaging across survey plots within each visit, followed by averaging across visits within the season. Overall mean use was calculated as a weighted average of seasonal values by the number of days in each season.

Mean diurnal raptor use at the Project was compared to other projects using data from the first 20 min of the 60-min survey. Some other projects in the region have implemented 20-min large bird surveys instead of full 60-min surveys. By using only the first 20 min of the large bird use data, raptor use values for the Project were able to be compared to projects with 20-min large bird use surveys.

Percent of use was calculated as the proportion of large bird mean use that was attributable to a particular bird type or species. Frequency of occurrence was calculated as the percent of surveys in which a particular bird type or species was observed. When considered together, frequency of occurrence and percent of use provide relative measures of species use of the proposed Project.

Eagle Minutes

Total eagle min were defined as the total min an eagle was observed during a scheduled large bird use survey, regardless of distance, activity, or flight height AGL. Following survey protocols described in the ECPG (USFWS 2013), eagle risk min were defined as the number of min an eagle was observed flying within three-dimensional plots (i.e., cylinders) that included the area within the 2,625-ft radius survey plots and up to 656 ft (200 m) AGL during the 60-min survey periods. Therefore, observations of perched eagles or of eagles flying beyond the cylinder did not apply to eagle risk min, but did apply to total eagle min.

Bird Flight Height Characteristics

Bird flight heights are important metrics to assess potential exposure. Flight height information was used to calculate the percentage of birds observed flying within the rotor-swept height (RSH) for turbines likely to be used at the Project. An RSH for potential collision with a turbine blade of 82–492 ft (25–150 m) AGL was used for the purposes of the analysis. Only observations first recorded as flying within the 2,625-ft radius survey plot were included in this analysis. The flight height recorded during the initial observation was used to calculate mean flight heights and the percentage of birds flying within each height category (below RSH, within RSH, and above RSH). The percentage of birds flying within the RSH at any time was calculated using the lowest and highest flight heights recorded.

Collision Risk Exposure Index

The collision risk exposure index is used as a relative measure of species-specific risk of turbine blade collision and the species most likely to occur as fatalities at the proposed Project. A relative index of bird collision exposure (R) was calculated for bird species observed during the large bird surveys using the following formula:

$$R = A*P_f*P_t$$

where A equals mean relative use for species *i* (large bird observations within 2,625-ft of the observer) averaged across all surveys, P_f equals the proportion of all observations of species *i* where the first activity was recorded as flying (an index to the approximate percentage of time species *i* spends flying during the daylight period), and P_t equals the proportion of all initial flight height observations of species *i* within the likely RSH. The exposure index does not account for other possible collision risk factors, such as foraging or courtship behavior.

Spatial Use

Large bird spatial use was evaluated using mean use for each survey plot. For each species and bird type, the number of individuals observed at each survey plot during the 60-min survey was divided by the total number of surveys conducted at that survey plot.

Eagle flight paths were mapped during large bird use surveys and digitized to qualitatively show flight locations and flight direction (north/south, east/west) within survey plots compared to topographic features within the Project area to identify any areas of concentrated use and/or consistent flight patterns.

Incidental Observations

Incidental observations provided records of bird species seen outside of the standardized surveys. Similar to standardized surveys, biologists recorded the date, time, observation number, species, number of individuals, sex/age class, distance from observer, flight height AGL, flight direction (for flying observations), and activity for incidental bird observations. Incidental observations included raptors and sensitive species (see Sensitive Species Observations section). Incidental observations were not included in analyses.

Sensitive Species Observations

Sensitive species observed during large bird use surveys and incidentally were recorded. Sensitive species included federally protected species (i.e., protected under the Endangered Species Act [ESA; Public Law [Pub. L] 93 – 205 1973]; Bald and Golden Eagle Protection Act [BGEPA; 16 United States Code [USC] Section [§] 668 1940), USFWS Birds of Conservation Concern (BCC; USFWS 2008); as well as North Dakota Species of Conservation Priority (SCP; Dyke et al. 2015).

North Dakota does not have an endangered or threatened species list but rather a list of SCP which includes mammals, reptiles, amphibians, fish, and freshwater mussels. Species designated as a SCP by North Dakota Game and Fish Department (NDGFD) are placed in one of three levels used to prioritize funding for State Wildlife Grant projects (SWG; Dyke et al. 2015). Level I (LI) SCP includes species in decline in North Dakota or across their range, or species with core breeding range within North Dakota. Level II (LII) SCP includes species of moderate conservation priority or species with high level of conservation priority but with substantial non-SWG funding available; federally threatened and endangered species are assigned LII status. Level III (LIII) SCP includes species of moderate conservation priority that do not breed in North Dakota.

RESULTS

Large Bird Use Surveys

A total of 236 hours of survey were conducted during 12 visits from April 4, 2017 – March 27, 2018 (Table 1). Independent of distance to observer, 15,226 bird observations within 144 separate groups (defined as one or more individual birds) were recorded (Appendix A).

Table 1. Number of visits, surveys, bird species diversity (number of species[a]) and species richness[b] by season and overall observed during the 60-minute large bird use surveys conducted within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan counties, North Dakota, from April 4, 2017 – March 27, 2018.

Season	Number of Visits	Number of Surveys Conducted	Species Diversity	Species Richness
Spring	3	58	18	0.75
Summer	3	65	11	0.55
Fall	2	46	9	0.52
Winter	4	67	3	0.11
Overall	**12**	**236**	**28**	**0.47**

[a]. Regardless of distance from observer.

[b]. Number of species per 2,625-foot (800-meter) radius survey plot per 60-minute survey.

Bird Diversity and Species Richness

Twenty-eight identified species were observed during large bird use surveys (Table 1). Bird diversity (the number of identified species observed) was highest during the spring (18 species), followed by summer (11), fall (nine), and winter (three). Overall, a mean of 0.47 large bird species/plot/survey was recorded; species richness was highest during the spring (0.75 species/plot/survey), followed by summer (0.55), fall (0.52), and winter (0.11; Table 1).

Two identified species (7.1% of all species) accounted for 97.9% of all observations: snow goose (*Chen caerulescens*; 14,398 observations in 14 groups) and sandhill crane (*Antigone canadensis*; 502 observations in 14 groups). All other species each accounted for less than 0.4% each of the observations (Appendix A).

Sixty-six diurnal raptors were recorded within the Project, representing seven species (Appendix A). Diurnal raptors accounted for 0.4% of all large bird observations, with northern harrier (*Circus cyaneus*; 22 observations in 21 groups), red-tailed hawk (*Buteo jamaicensis*; 19 observations in 19 groups) and Swainson's hawk (*Buteo swainsoni*; 15 observations in 15 groups) composing the majority of the diurnal raptor observations (Appendix A). One bald eagle and one golden eagle observation were each recorded during the winter season (Appendix A).

Bird Use, Percent of Use, and Frequency of Occurrence

Mean bird use, percent of use, and frequency of occurrence were calculated by season for all bird types, raptor subtypes, and species using the data collected during the 60-min large bird use surveys (Table 2; Appendix B). The highest overall large bird use occurred during winter (136.03 birds/plot/survey), followed by spring (54.48), fall (8.80), and summer (1.00). The high winter use was mainly attributed to waterfowl use during that season (135.96 birds/plot/survey), especially use by snow geese (Appendix B).

Diurnal Raptors

Diurnal raptor use was highest during fall (0.48 birds/plot/survey), followed by summer (0.31) and spring (0.23); lowest use occurred in winter (0.07; Table 2). Higher raptor use during the fall was primarily due to use of the area by Swainson's hawk, red-tailed hawk and northern harrier. Swainson's hawk and northern harrier had the highest use by diurnal raptors in the fall (0.17 each); while red-tailed hawk had the highest use during summer (0.17). In winter, the only observed diurnal raptors were bald and golden eagles (0.02 large birds/plot/survey) and unidentified raptors (0.05; Appendix B). Diurnal raptors accounted for 36.8% of the overall large bird use during all four seasons. Diurnal raptors were observed from 21.7% – 28.3% of surveys in spring through fall surveys; compared to only 6.9% of winter surveys (Table 2).

For comparison purposes (historically the majority of publically available projects were only conducted for 20 min), diurnal raptor use was also calculated for a 20-min survey period. By using only the first 20 min of the large bird use data, diurnal raptor use was calculated to be 0.18 raptors/plot/20-min survey.

Eagles

Eagles were observed during large bird use surveys in the winter only (0.02 birds/plot/survey; Table 2). Mean use for bald eagle and golden eagle were the same (0.01 birds/plot/survey). Bald and golden eagles accounted for less than 0.1% each of overall large bird use in winter (Table 2; Appendix B). Eagles were observed during 2.2% of winter surveys (Table 2); frequency of occurrence was the same for bald and golden eagles (1.1%; Appendix B).

Eagle Minutes

A total of two eagle observations were documented for a total of three eagle minutes (i.e., regardless of distance from observer, activity, or flight height AGL) during 236 large bird use survey observation hours (14,160 min; Table 3); all of the total eagle min were also risk min (i.e., within the 2,625-ft) radius by 656-ft high circular cylinder; Table 3). Eagles were only

documented during the winter, with one bald eagle being recorded for one total min (one eagle risk min) at Point 5 on November 13, 2017, and one golden eagle being recorded for two total min (two eagle risk min) at Point 19 on November 14, 2017 (Table 3). Bald and golden eagle flight paths are shown in Figure 3.

Waterfowl

Waterfowl accounted for the majority of overall large bird use in winter and spring. Waterfowl had the highest use during winter (135.96 birds/plot/survey), followed by spring (46.93), and fall (6.41; Table 2). No waterfowl were documented during the summer. Higher waterfowl use during the winter and spring were due to several large groups of snow geese (Appendix B). Waterfowl accounted for 99.9% of use in winter, 86.1% in spring, and 72.8% of use in fall (Appendix B). Waterfowl were observed more frequently during the spring (17.1%), followed by fall (4.3%) and winter (4.3%; Table 2).

Table 2. Mean large bird use (number of large birds/plot/survey)[a], percent of total use, and frequency of occurrence by major large bird type, raptor subtype, and season, observed during the 60-minute (min) large bird use surveys conducted within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan counties, North Dakota, from April 4, 2017 – March 27, 2018.

	Mean Use				Percent of Use (%)				Frequency of Occurrence (%)			
Bird Type/Subtype/Species	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**
Waterbirds	**7.00**	**0.02**	**1.85**	**0**	**12.8**	**1.7**	**21.0**	**0**	**5.8**	**1.7**	**4.3**	**0**
Waterfowl	**46.93**	**0**	**6.41**	**135.96**	**86.1**	**0**	**72.8**	**99.9**	**17.1**	**0**	**4.3**	**4.3**
Shorebirds	**0.01**	**0.13**	**0**	**0**	**<0.1**	**13.4**	**0**	**0**	**1.4**	**8.9**	**0**	**0**
Gulls/Terns	**0**	**0.38**	**0**	**0**	**0**	**37.8**	**0**	**0**	**0**	**1.5**	**0**	**0**
Diurnal Raptors	**0.23**	**0.31**	**0.48**	**0.07**	**0.4**	**31.0**	**5.4**	**<0.1**	**21.7**	**28.1**	**28.3**	**6.9**
Accipiters	*0*	*0*	*0.02*	*0*	*0*	*0*	*0.2*	*0*	*0*	*0*	*2.2*	*0*
Buteos	*0.09*	*0.23*	*0.28*	*0*	*0.2*	*23.3*	*3.2*	*0*	*8.7*	*21.9*	*21.7*	*0*
Northern Harrier	*0.13*	*0.08*	*0.17*	*0*	*0.2*	*7.7*	*2.0*	*0*	*11.6*	*7.7*	*15.2*	*0*
Eagles	*0*	*0*	*0*	*0.02*	*0*	*0*	*0*	*<0.1*	*0*	*0*	*0*	*2.2*
Falcons	*0.01*	*0*	*0*	*0*	*<0.1*	*0*	*0*	*0*	*1.4*	*0*	*0*	*0*
Other Raptors	*0*	*0*	*0*	*0.05*	*0*	*0*	*0*	*<0.1*	*0*	*0*	*0*	*4.7*
Vultures	**0.01**	**0.03**	**0**	**0**	**<0.1**	**3.1**	**0**	**0**	**1.4**	**3.1**	**0**	**0**
Upland Game Birds	**0.07**	**0.06**	**0.07**	**0**	**0.1**	**5.8**	**0.7**	**0**	**7.2**	**5.8**	**2.2**	**0**
Doves/Pigeons	**0.19**	**0.07**	**0**	**0**	**0.3**	**7.2**	**0**	**0**	**5.8**	**2.9**	**0**	**0**
Large Corvids	**0.03**	**0**	**0**	**0**	**<0.1**	**0**	**0**	**0**	**2.9**	**0**	**0**	**0**
Large Birds Overall	**54.48**	**1.00**	**8.80**	**136.03**	**100**	**100**	**100**	**100**				

[a.] 2,625-foot (800-meter) radius survey plot; 60-min surveys.

Table 3. Survey effort, number of eagle observations, total eagle minutes[a], and eagle risk minutes[b] recorded during the 60-minute large bird use surveys conducted at the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan counties, North Dakota, from April 4, 2017 – March 27, 2018.

	Survey Effort		Number of Observations		Total Eagle Minutes		Eagle Risk Minutes	
Season	**Hours**	**Minutes**	**BAEA**	**GOEA**	**BAEA**	**GOEA**	**BAEA**	**GOEA**
Spring	58	3,480	0	0	0	0	0	0
Summer	65	3,900	0	0	0	0	0	0
Fall	46	2,760	0	0	0	0	0	0
Winter	67	4,020	1	1	1	2	1	2
Total	**236**	**14,160**	**1**	**1**	**1**	**2**	**1**	**2**

BAEA = bald eagle; GOEA = golden eagle.

[a.] Regardless of activity, distance from observer, or flight height above ground level (AGL).

[b.] Flying within 2,625 feet (ft; 800 meter [m]) and below 656 ft (200 m) AGL.

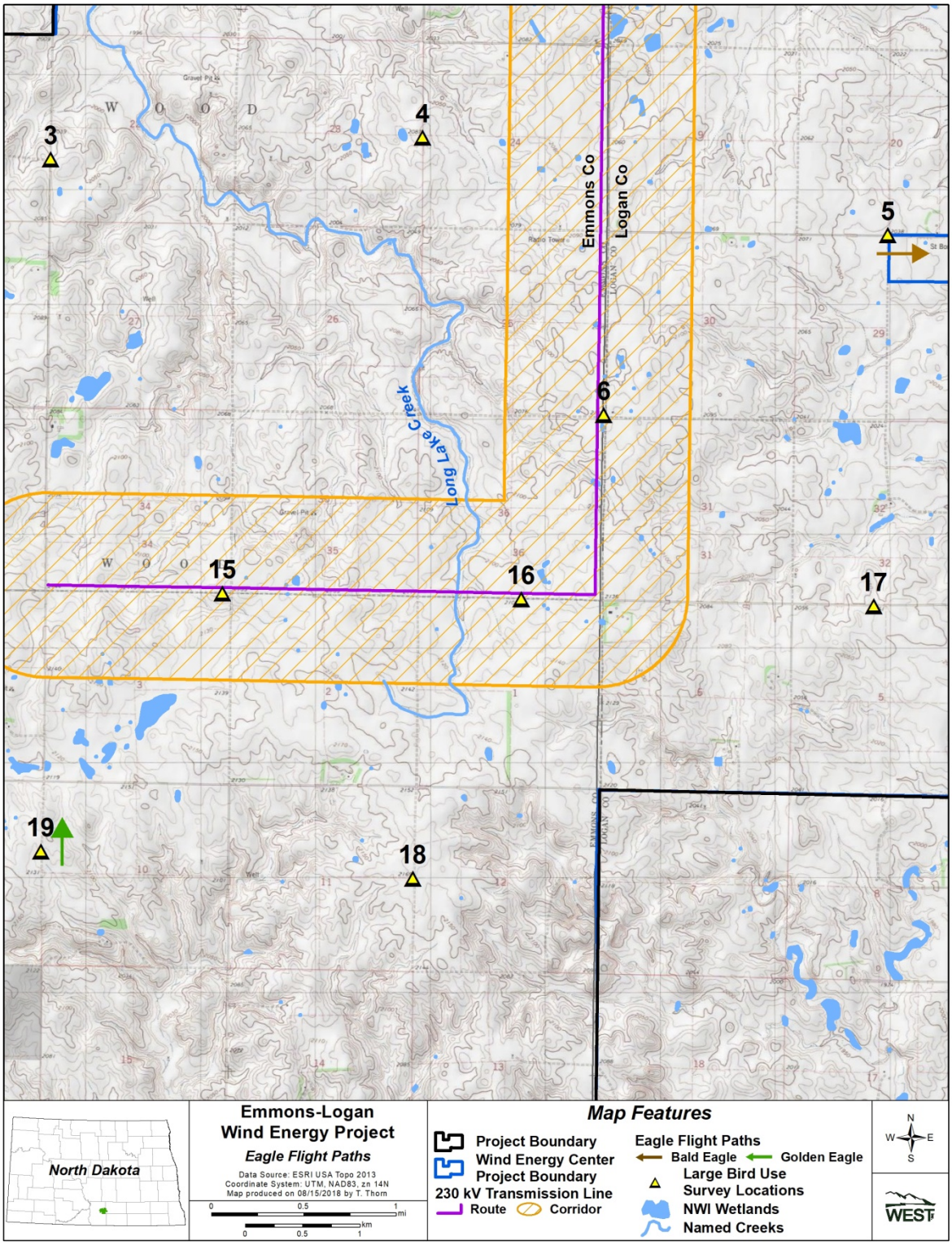

Figure 3. Bald eagle and golden eagle flight paths within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line, Emmons and Logan counties, North Dakota, from April 4, 2017 – March 27, 2018.

Bird Flight Height Characteristics

Flight height characteristics for observations included in analysis (i.e., observations first recorded as flying) were estimated based on initial flight height observation, for both bird types and species (Table 4, Appendix C). During the 60-min large bird use surveys, 99 groups of large birds were observed flying within the 2,625-ft radius survey plot, totaling 15,041 individuals (Table 4). Mean flight heights varied by bird type, with upland game birds having the lowest mean flight height (6.56 ft [2.00 m] AGL) and waterbirds having the highest (2,080.61 ft [634.17 m] AGL; Table 4). All gulls and terns, diurnal raptors, and vultures, were flying (100% of observations) when first observed.

Table 4. Flight height characteristics based on initial observation[a] by bird type and raptor subtype recorded during the 60-minute large bird use surveys[b] conducted within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan counties, North Dakota, from April 4, 2017 – March 27, 2018.

Bird Type/Subtype	Number of Groups Flying	Number Observed Flying	Mean Flight Height (meters m])	Percent Observed Flying (%)	Percent Within Flight Height Categories (%)		
					< 25 m	25–150 m[c]	> 150 m
Waterbirds	**12**	**463**	**634.17**	**81.4**	**0**	**14.3**	**85.7**
Waterfowl	**23**	**14,481**	**275.26**	**99.7**	**0.1**	**77.3**	**22.5**
Shorebirds	**4**	**4**	**9.50**	**40.0**	**100**	**0**	**0**
Gulls/Terns	**1**	**25**	**100**	**100**	**0**	**100**	**0**
Diurnal Raptors	**50**	**51**	**58.92**	**79.7**	**49.0**	**45.1**	**5.9**
Accipiters	*1*	*1*	*2.00*	*100*	*100*	*0*	*0*
Buteos	*23*	*23*	*61.48*	*67.6*	*26.1*	*73.9*	*0*
Northern Harrier	*20*	*21*	*9.35*	*95.5*	*81.0*	*19.0*	*0*
Eagles	*2*	*2*	*70.00*	*100*	*0*	*100*	*0*
Falcons	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Other Raptors	*4*	*4*	*300.75*	*100*	*25.0*	*0*	*75.0*
Vultures	**3**	**3**	**44.00**	**100**	**33.3**	**66.7**	**0**
Upland Game Birds	**1**	**3**	**2.00**	**25.0**	**100**	**0**	**0**
Doves/Pigeons	**4**	**10**	**8.75**	**55.6**	**100**	**0**	**0**
Large Corvids	**1**	**1**	**20.00**	**50.0**	**100**	**0**	**0**
Overall	**99**	**15,041**	**173.88**	**98.8**	**0.4**	**75.2**	**24.3**

[a.] Only observations first recorded as flying were included.

[b.] 2,625-feet (ft; 800-meter [m])radius survey plot for large birds.

[c.] The likely "rotor-swept height" for potential collision with a turbine blade, or 82–492 ft (25–150 m) above ground level.

The majority (75.2%) of flying large birds were first recorded flying within the RSH for collision with turbine blades of 82–492 ft AGL. Gulls and terns, waterfowl, and vultures, had the highest percentage of flying birds recorded within the RSH (100%, 77.3%, and 66.7%, respectively), while shorebirds, upland gamebirds, doves/pigeons, and large corvids, were observed flying exclusively below the RSH (Table 4). Waterbirds had the highest percentage (85.7%) of all large birds flying above the RSH, with a mean flight height of 2,080.61 ft (634.17 m) AGL (Table 4). Diurnal raptors were observed flying mostly below (49.0%) and within (45.1%) the RSH (Table 4). Eagles and buteos had the highest percentage of all raptors flying within the RSH (100% and

73.9%, respectively; Table 4). Appendix C shows the flight characteristics for each species observed during the large bird use surveys.

Collision Risk Exposure Index

A relative collision risk exposure index based on initial flight height observations and relative abundance (defined as the use estimate) was calculated for each bird species (Appendix C). Those species that flew within the RSH are listed in Tables 4 and 5. Snow goose had the highest exposure index (41.07), compared to an exposure index of less than 0.30 for all other large bird species. Three of the six large birds with an exposure index greater than zero were raptors (Table 5). All raptor species had an exposure index of 0.05 or less. The red-tailed hawk had the highest index at 0.05.

Table 5. Flight characteristics and relative collision risk exposure index for bird species[a] observed during the 60-minute large bird use surveys[b] at the Emmons-Logan Wind Energy Center and 230 kV Transmission Line from April 4, 2017 – March 27, 2018.

Species	Number of Groups Flying	Overall Mean Use	Percent Flying (%)	Percent Flying Within RSH[c] Based on Initial Observation (%)	Exposure Index	Percent Within RSH at Any Time (%)
snow goose	14	52.80	100	77.8	41.07	77.8
American white pelican	1	0.28	100	100	0.28	100
ring-billed gull	1	0.10	100	100	0.10	100
red-tailed hawk	14	0.08	73.7	92.9	0.05	92.9
Swainson's hawk	9	0.06	60.0	44.4	0.02	77.8
northern harrier	20	0.09	95.5	19.0	0.02	19.0
turkey vulture	3	0.01	100	66.7	<0.01	66.7
double-crested cormorant	1	<0.01	100	100	<0.01	100
golden eagle	1	<0.01	100	100	<0.01	100
bald eagle	1	<0.01	100	100	<0.01	100

[a.] Based on flight characteristics when first observed. Only observations first recorded as flying were included in this analysis.

[b] 2,625-foott (ft; 800-meter [m]) radius survey plot for large birds.

[c.] The likely "rotor-swept height" for potential collision with a turbine blade, or 82–492 ft (25–150 m) above ground level.

Spatial Use

For all large bird species combined, use was highest at Point 5 (888.83 birds/60-min survey) and ranged from 0.22–171.83 at all other points (Figure 4a, Appendix D). Diurnal raptor use was observed at all points with the exception of Point 17; raptor use was highest at Point 10 (0.88 birds/60-min survey), and ranged from zero–0.58 at other points (Figure 4b, Appendix D). Buteos and northern harrier contributed to the majority of diurnal raptor use. Buteo use was highest at Point 16 (0.38 birds/60-min survey) and ranged from zero–0.33 at other points (Figure 4d, Appendix D). Northern harrier use was highest at Point 10 (0.50 birds/60-min survey) and ranged from zero–0.29 at other points (Figure 4e, Appendix D). Eagle use occurred at Point 5 (0.08) and at Point 19 (0.08; Figures 3 and 4c, Appendix D). Waterfowl use was

observed at 10 of the 23 survey points, with higher use at Points 5, 17, 20, and 22 (Figure 4f, Appendix D).

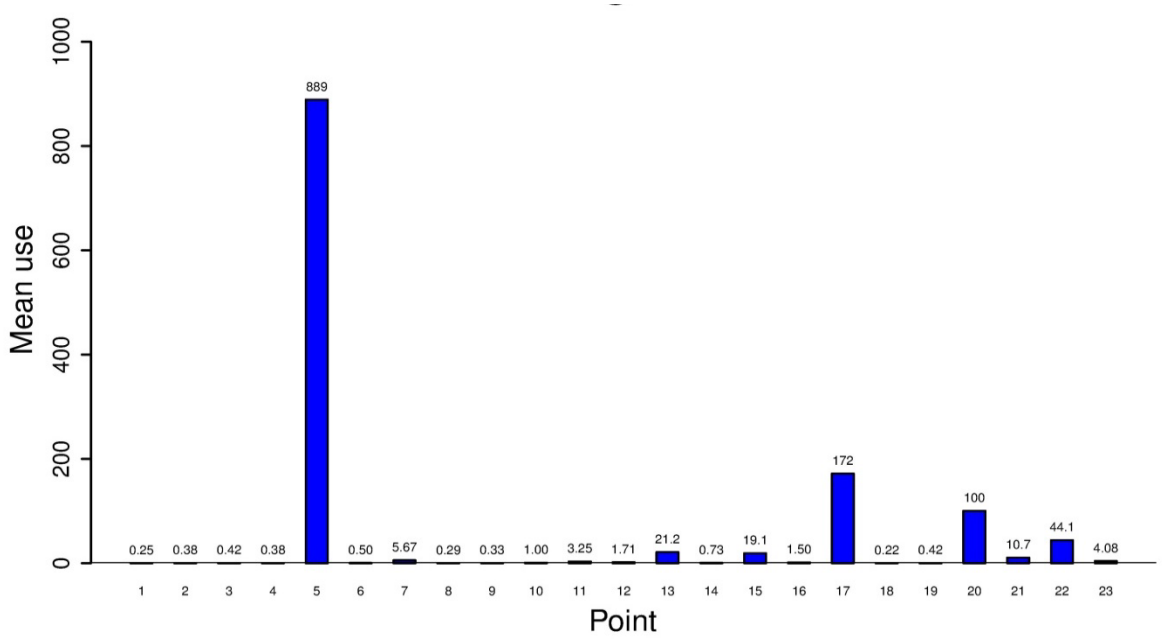

Figure 4a. Mean large bird use (number of birds/60-minute survey) by survey point recorded during the large bird use surveys conducted within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan counties, North Dakota, from April 4, 2017 – March 27, 2018.

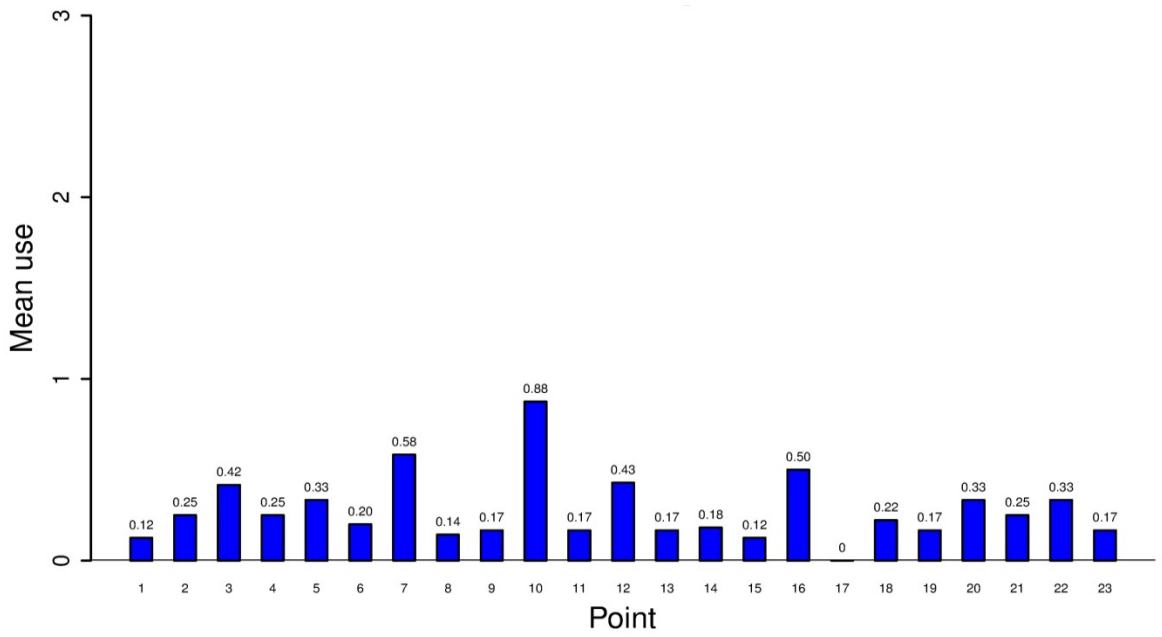

Figure 4b. Mean diurnal raptor use (number of birds/60-minute survey) by point recorded during the large bird use surveys conducted within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan counties, North Dakota, from April 4, 2017 – March 27, 2018.

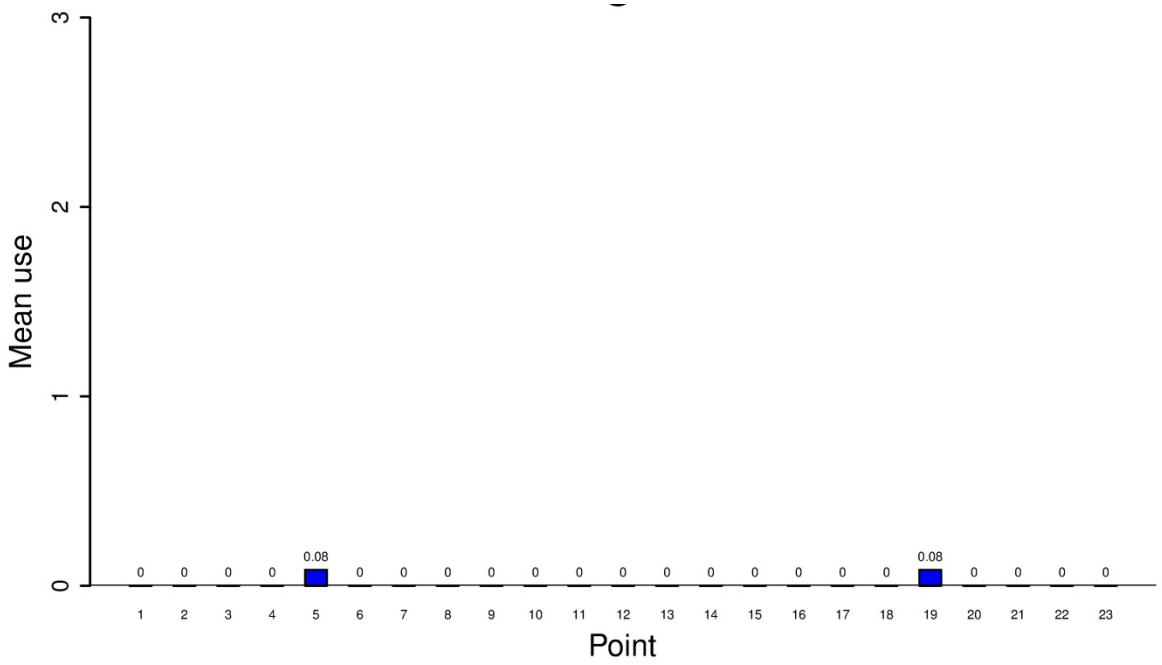

Figure 4c. Mean eagle use (number of birds/60-minute survey) by point recorded during the large bird use surveys conducted within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan counties, North Dakota, from April 4, 2017 – March 27, 2018.

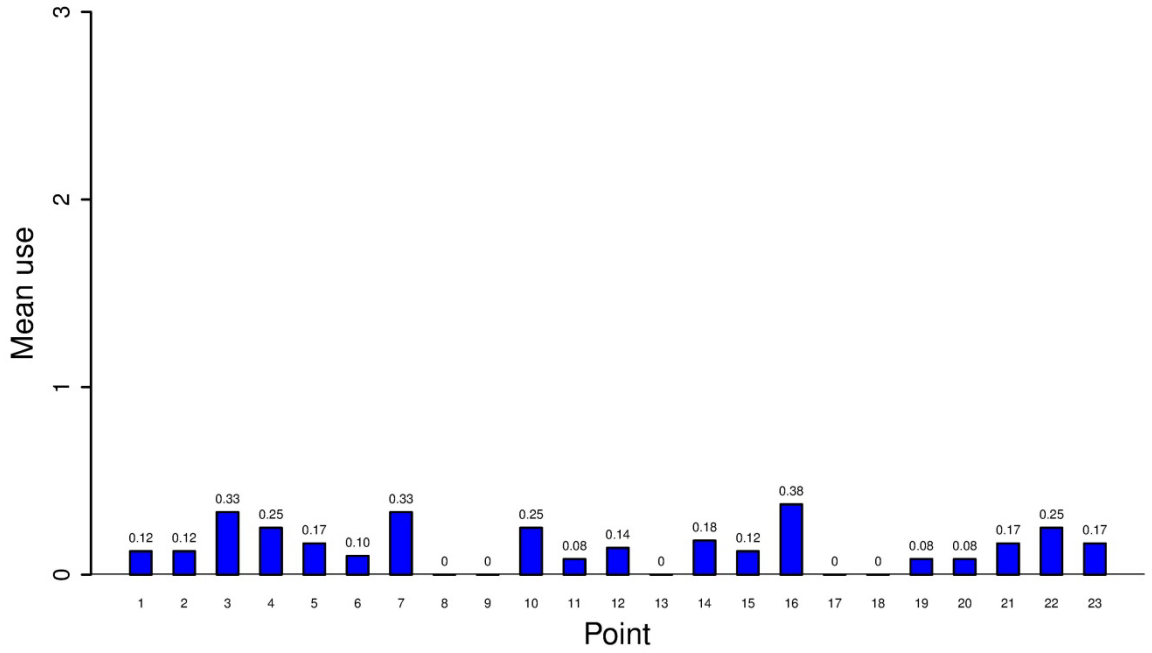

Figure 4d. Mean buteo use (number of birds/60-minute survey) by point recorded during the large bird use surveys conducted within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan counties, North Dakota, from April 4, 2017 – March 27, 2018.

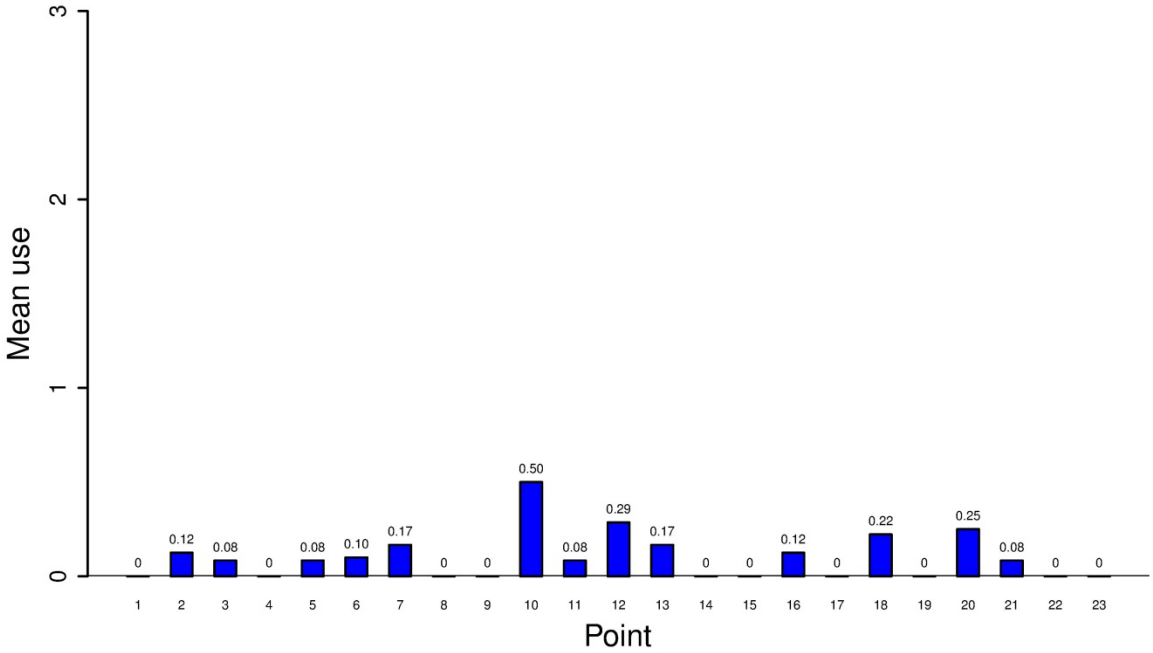

Figure 4e. Mean northern harrier use (number of birds/60-minute survey) by point recorded during the large bird use surveys conducted within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan counties, North Dakota, from April 4, 2017 – March 27, 2018.

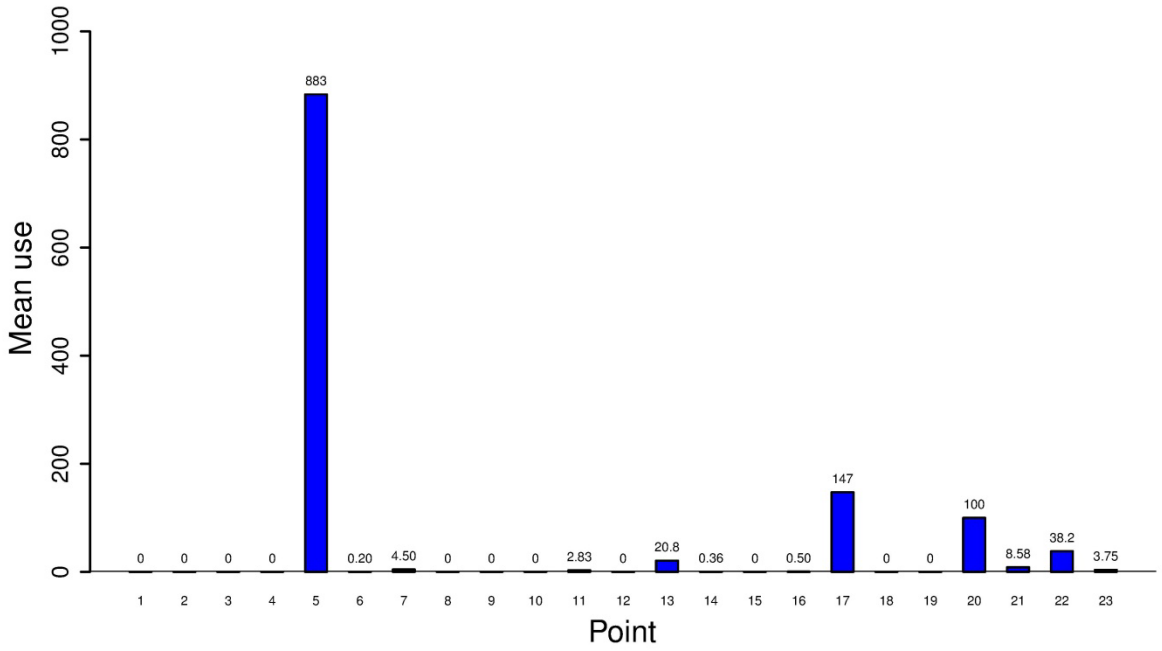

Figure 4f. Mean waterfowl use (number of birds/60-minute survey) by survey point recorded during the large bird use surveys conducted within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan counties, North Dakota, from April 4, 2017 – March 27, 2018.

Incidental Observations

Eight bird species were observed incidentally during the one-year survey period within the Project area, totaling 36 birds within 33 separate groups (Table 6). Three diurnal raptor species, including bald eagle, northern harrier, and red-tailed hawk were recorded incidentally. Additionally, two separate observations of a snowy owl were recorded (Table 6).

Table 6. Incidental observations recorded during the one-year survey period conducted within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan counties, North Dakota, from April 4, 2017 – March 27, 2018.

Species	Scientific Name	Number of Groups	Number of Observations
bald eagle	*Haliaeetus leucocephalus*	1	1
bobolink	*Dolichonyx oryzivorus*	4	5
chestnut-collared longspur	*Calcarius ornatus*	1	1
lark bunting	*Calamospiza melanocorys*	3	3
northern harrier	*Circus cyaneus*	1	1
red-tailed hawk	*Buteo jamaicensis*	2	4
sharp-tailed grouse	*Tympanuchus phasianellus*	2	2
snowy owl	*Bubo scandiacus*	2	2
Sprague's pipit	*Anthus spragueii*	1	1
western meadowlark	*Sturnella neglecta*	16	16
Total		**33**	**36**

Sensitive Species Observations

Fourteen sensitive species were recorded during large bird use surveys (Table 7), none of which were federally endangered, threatened, candidate, or proposed species under the ESA (Pub. L. 93–205 1973). All 14 sensitive species are LI and LII North Dakota SCP (Dyke et al. 2015). No LIII SCP were recorded. One bald eagle and one golden eagle were documented during scheduled large bird use surveys and one additional bald eagle was documented incidentally within the Project area (Table 7). Both the bald eagle and golden eagle are protected under BGEPA (16 USC § 668 1940), and the bald eagle is also a USFWS BCC (USFWS 2008). The chestnut-collared longspur (*Calcarius ornatus*), marbled godwit (*Limosa fedoa*), Sprague's pipit (*Anthus spragueii*), Swainson's hawk, and upland sandpiper (*Bartramia longicauda*) are also USFWS BCC (Table 7).

Table 7. Sensitive species (number [#] of groups [Grps] and # of observations [Obs]) recorded during the 60-minute large bird use surveys and incidentally, within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan counties, North Dakota, from April 4, 2017 – March 27, 2018.

			Use Surveys		Incidental		Total	
Species	**Scientific Name**	**Status**	**# of Grps**	**# of Obs**	**# of Grps**	**# of Obs**	**# of Grps**	**# of Obs**
American white pelican	*Pelecanus erythrorhynchos*	LII	1	65	0	0	1	65
bald eagle	*Haliaeetus leucocephalus*	LII; BGEPA; BCC	1	1	1	1	2	2
bobolink	*Dolichonyx oryzivorus*	LII	0	0	4	5	4	5
chestnut-collared longspur	*Calcarius ornatus*	LI; BCC	0	0	1	1	1	1
golden eagle	*Aquila chrysaetos*	LII; BGEPA	1	1	0	0	1	1
lark bunting	*Calamospiza melanocorys*	LI	0	0	3	3	3	3
marbled godwit	*Limosa fedoa*	L; BCC	3	3	0	0	3	3
northern harrier	*Circus cyaneus*	LII	21	22	1	1	22	23
northern pintail	*Anas acuta*	LII	4	8	0	0	4	8
sharp-tailed grouse	*Tympanuchus phasianellus*	LII	1	3	2	2	3	5
Sprague's pipit	*Anthus spragueii*	LI; BCC	0	0	1	1	1	1
Swainson's hawk	*Buteo swainsoni*	LI; BCC	15	15	0	0	15	15
upland sandpiper	*Bartramia longicauda*	LII; BCC	5	6	0	0	5	6
western meadowlark	*Sturnella neglecta*	LII	0	0	16	16	16	16
Total	**14 Species**		**52**	**124**	**29**	**30**	**81**	**154**

LI = Level I North Dakota Species of Conservation Priority (NDSCP; Dyke et al. 2015)

LII = Level II NDSCP (NDGF 2016)

BGEPA = Bald and Golden Eagle Protection Act (16 USC § 668 1940)

BCC = Birds of Conservation Concern (USFWS 2008)

DISCUSSION

The WEG (USFWS 2012) use a tiered approach to assess impacts to species and their habitats. Tier 3 studies, as defined in the WEG, are designed to address questions regarding impact that cannot be sufficiently addressed using available literature (i.e., Tiers 1 and 2 desktop analyses). Avian use surveys are one of a suite of Tier 3 studies used as part of risk analyses. These studies provide additional site-specific data that, when combined with available literature reviewed in previous Tiers, allow for a confident assessment of the risk of significant adverse impacts to species of concern; assist in identifying measures to mitigate significant adverse impacts, if necessary; and/or identify a need for more field studies. While the avian use surveys reported herein were conducted across all large bird species observed, the report focuses on a smaller group of species (i.e., diurnal raptors, eagles, state/federally listed species, and LI, LII, and LIII North Dakota SCP).

Potential Impacts

Diurnal Raptors

Overall mean diurnal raptor use, calculated using the first 20 min of raptor data to be comparable to other wind energy projects, was 0.18 raptors/plot/20-min survey. The annual mean diurnal raptor use at other wind energy facilities in central and western US ranged from 0.06–2.34 raptors/plot/20-min survey (Figure 5). Compared to 48 projects with publicly available data from the central and western US that implemented similar study seasons and methods, annual mean diurnal raptor use at the Project is low, ranking 42nd (Figure 5).

Publicly available data containing both mean raptor use and raptor fatality information in the Midwest are scarce (Appendix E), while data having this information for four seasons are even scarcer. In the Midwest, comparable pre-construction raptor use and post-construction raptor mortality data are only available from three studies in Illinois and South Dakota (Grand Ridge 2009, Wessington Springs 2009; and Wessington Springs 2010; Appendix E). All three studies indicated relatively low raptor use (0.23 raptors/Megawatt [MW]/year or less) and low raptor fatality estimates (0.07 fatalities/MW/year or less; Appendix E). Mean raptor use within the Project area was lower than that reported at the above-mentioned South Dakota and Illinois facilities (Appendix E), which may suggest that the raptor fatality rate within the Project may be within the range of fatalities observed at other regional projects (Figure 6). However, due to the relatively limited results and other biological factors that can influence raptor fatality rates, it is not known if the relationship between raptor use and fatality rates is a simple linear relationship (Ferrer et al. 2011).

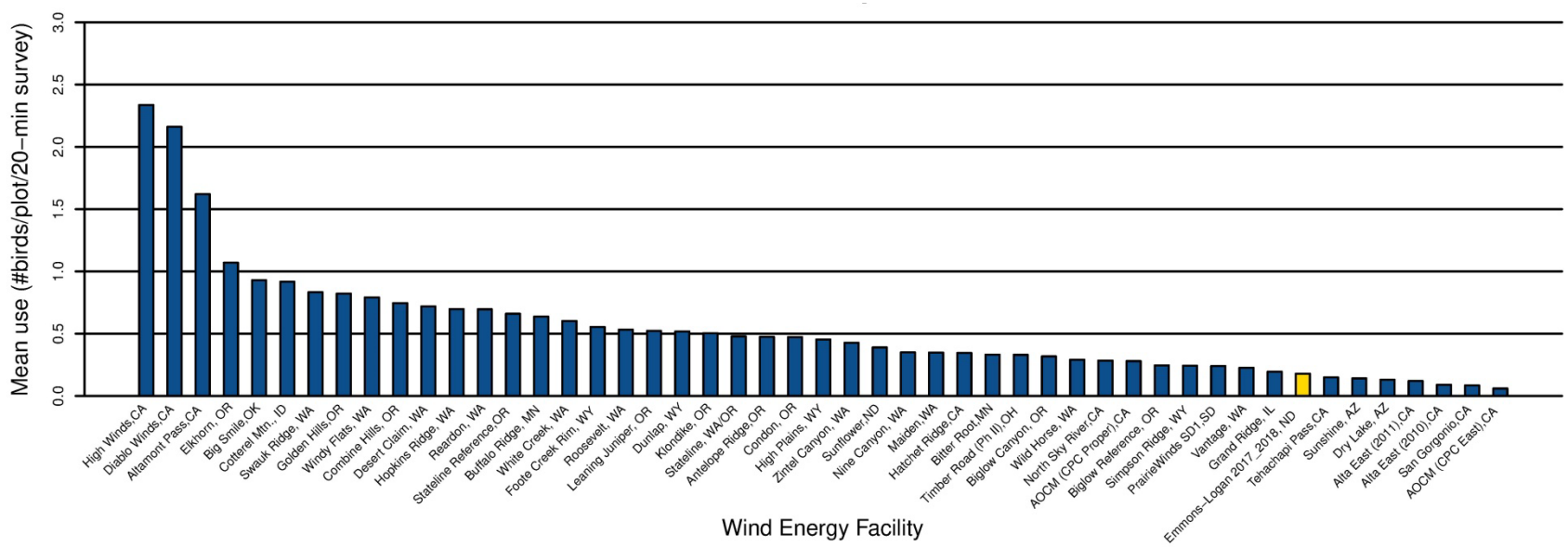

Figure 5. Comparison of estimated annual diurnal raptor use (number [#] of bird/plot/20-minute survey) within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan counties, North Dakota, from April 4, 2017 – March 27, 2018, and diurnal raptor use at other wind resource areas in central and western US with three or four seasons of raptor use data.

Data from the following sources:

Study and Location	Reference	Study and Location	Reference	Study and Location	Reference
Emmons-Logan 2017-2018, ND	**This Study**	Foote Creek Rim, WY	Johnson et al. 2000b	Wild Horse, WA	Erickson et al. 2003d
High Winds, CA	Kerlinger et al. 2005	Roosevelt, WA	NWC and WEST 2004	North Sky River, CA	Erickson et al. 2011
Diablo Winds, CA	WEST 2006	Leaning Juniper, OR	Kronner et al. 2005	AOCM (CPC Proper), CA	Chatfield et al. 2010
Altamont Pass, CA	Orloff and Flannery 1992	Dunlap, WY	Johnson et al. 2009a	Biglow Reference, OR	WEST 2005c
Elkhorn, OR	WEST 2005a	Klondike, OR	Johnson et al. 2002a	Simpson Ridge, WY	Johnson et al. 2000b
Big Smile (Dempsey), OK	Derby et al. 2010b	Stateline, WA/OR	Erickson et al. 2003b	PrairieWinds SD1,SD	Derby et al. 2010c
Cotterel Mtn., ID	BLM 2006	Antelope Ridge, OR	WEST 2009	Vantage, WA	Jeffrey et al. 2007
Swauk Ridge, WA	Erickson et al. 2003c	Condon, OR	Erickson et al. 2002b	Grand Ridge, IL	Derby et al. 2009
Golden Hills, OR	Jeffrey et al. 2008	High Plains, WY	Johnson et al. 2009b	Tehachapi Pass, CA	Anderson et al. 2000, Erickson et al. 2002b
Windy Flats, WA	Johnson et al. 2007	Zintel Canyon, WA	Erickson et al. 2002a, 2003a	Sunshine, AZ	WEST and the CPRS 2006
Combine Hills, OR	Young et al. 2003a	Sunflower, ND	Derby and Thorn 2014	Dry Lake, AZ	Young et al. 2007a
Desert Claim, WA	Young et al. 2003b	Nine Canyon, WA	Erickson et al. 2001	Alta East (2011), CA	Chatfield et al. 2011
Hopkins Ridge, WA	Young et al. 2003c	Maiden, WA	Young et al. 2002	Alta East (2010), CA	Chatfield et al. 2011
Reardon, WA	WEST 2005b	Hatchet Ridge, CA	Young et al. 2007b	San Gorgonio, CA	Anderson et al. 2000, Erickson et al. 2002b
Stateline Reference, OR	URS et al. 2001	Bitter Root. MN	Derby and Dahl 2009	AOCM (CPC East), CA	Chatfield et al. 2010
Buffalo Ridge, MN	Johnson et al. 2000a	Timber Road (Phase II), OH	Good et al. 2010		
White Creek, WA	NWC and WEST 2005	Biglow Canyon, OR	WEST 2005c		

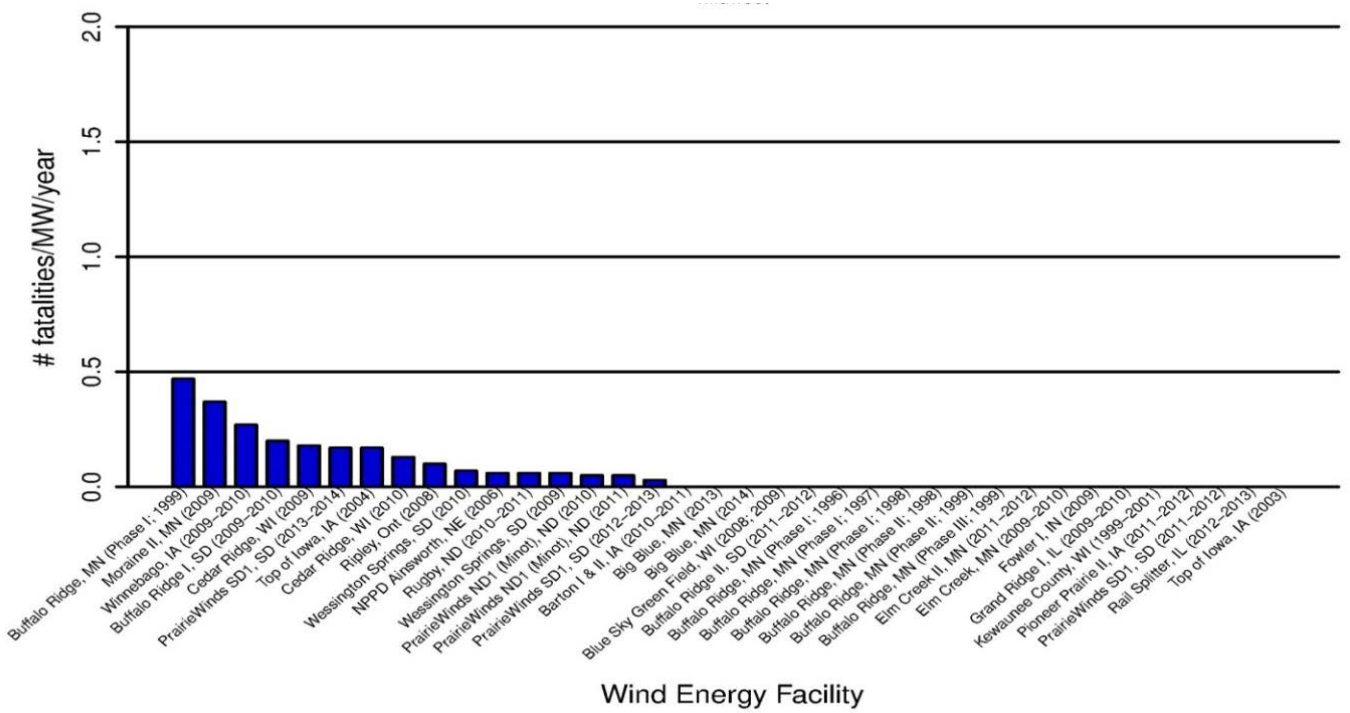

Figure 6. Fatality rates (number [#] of fatalities/megawatt [MW]/year) for raptors from publicly available data at wind energy facilities in the Midwest region of the US.

Data from the following sources:

Wind Energy Facility	Reference	Wind Energy Facility	Reference
Barton I & II, IA (10-11)	Derby et al. 2011b	Moraine II, MN (09)	Derby et al. 2010g
Big Blue, MN (13)	Fagen Engineering 2014	NPPD Ainsworth, NE (06)	Derby et al. 2007
Big Blue, MN (14)	Fagen Engineering 2015	Pioneer Prairie I, IA (Phase II; 11-12)	Chodachek et al. 2012
Blue Sky Green Field, WI (08; 09)	Gruver et al. 2009	PrairieWinds ND1 (Minot), ND (10)	Derby et al. 2011d
Buffalo Ridge, MN (Phase I; 96)	Johnson et al. 2000a	PrairieWinds ND1 (Minot), ND (11)	Derby et al. 2012d
Buffalo Ridge, MN (Phase I; 97)	Johnson et al. 2000a	PrairieWinds SD1 (Crow Lake), SD (11-12)	Derby et al. 2012c
Buffalo Ridge, MN (Phase I; 98)	Johnson et al. 2000a	PrairieWinds SD1 (Crow Lake), SD (12-13)	Derby et al. 2013
Buffalo Ridge, MN (Phase I; 99)	Johnson et al. 2000a	PrairieWinds SD1 (Crow Lake), SD (13-14)	Derby et al. 2014
Buffalo Ridge, MN (Phase II; 98)	Johnson et al. 2000a	Rail Splitter, IL (12-13)	Good et al. 2013
Buffalo Ridge, MN (Phase II; 99)	Johnson et al. 2000a	Ripley, Ont (08)	Jacques Whitford 2009
Buffalo Ridge I, SD (09-10)	Derby et al. 2010e	Rugby, ND (10-11)	Derby et al. 2011c
Cedar Ridge, WI (09)	BHE Environmental 2010	Top of Iowa, IA (03)	Jain 2005
Cedar Ridge, WI (10)	BHE Environmental 2011	Top of Iowa, IA (04)	Jain 2005
Elm Creek, MN (09-10)	Derby et al. 2010f	Wessington Springs, SD (09)	Derby et al. 2010d
Elm Creek II, MN (11-12)	Derby et al. 2012b	Wessington Springs, SD (10)	Derby et al. 2011a
Fowler I, IN (09)	Johnson et al. 2010	Winnebago, IA (09-10)	Derby et al. 2010h
Grand Ridge I, IL (09-10)	Derby et al. 2010a		

Bald Eagle

Bald eagles are found along major river systems, lakes, and reservoirs, bordered by large trees (used for nesting and roosting; NDGFD 2016a). The Project area generally lacks potential nesting habitat as there are limited large water bodies and mature large trees. There is more potential nesting habitat outside of the Project area as observed during the aerial raptor nest survey. No occupied bald eagle nests were located within the Project during the aerial raptor nests survey conducted in 2017; however, two occupied bald eagle nests and three additional nests that were consistent in size with an eagle nest were observed within the 10-mi (16-km) buffer (Derby et al. 2018) .

Eagle mortalities at wind facilities in the contiguous US (excluding Altamont Pass Wind Resource Area in California) were summarized from public domain data by Pagel et al. (2013). Three bald eagle fatalities were recorded in the Midwest (Iowa); these fatalities were recorded incidentally (not during a study) or for unknown reasons. WEST summarized publically-available study results from the Midwest and no bald eagle fatalities were observed during those studies (Table 8). Given the low susceptibility of bald eagles to collisions with wind turbines (Pagel et al. 2013), and the low eagle use within the Project area (one bald eagle documented for one total minute during large bird use surveys in the winter and one bald eagle recorded incidentally in the winter), construction and operation of a wind facility is unlikely to have significant adverse impacts on bald eagle populations.

Table 8. Raptor fatalities, by species, recorded at wind energy facilities in the Midwest region of the United States.

Species	Scientific Name	Number of Raptor Fatalities[a]	Percent Composition of Raptor Fatalities (%)
red-tailed hawk	*Buteo jamaicensis*	38	69.1
American kestrel	*Falco sparverius*	5	9.1
sharp-shinned hawk	*Accipiter striatus*	4	7.3
rough-legged hawk	*Buteo lagopus*	3	4.5
Cooper's hawk	*Accipiter cooperii*	2	3.6
merlin	*Falco columbarius*	1	1.8
Swainson's hawk	*Buteo swainsoni*	1	1.8
unidentified raptor		1	1.8
Total		**55**	**100**

[a] These are unadjusted, raw data. Cumulative fatalities and species are from data compiled by WEST, from publicly available fatality studies (a list of facilities and references are available upon request from WEST)

Golden Eagle

Pagel et al. (2013) summarized documented cases of eagle mortality at wind facilities in the contiguous US (excluding Altamont Pass Wind Resource Area in California) from 1997–2012; their study reported no golden eagle fatalities were recorded in the Midwest. Similarly, to date no golden eagle fatalities have been recorded at wind energy facilities in the Midwest, according to WEST's cumulative database (Table 8). Golden eagles, however, seem to be more vulnerable to collision than bald eagles at wind energy facilities in the continental US, with some apparent seasonal patterns in susceptibility (Pagel et al. 2013). Given that golden eagles are

considered uncommon permanent residents and rare winter visitors in central North Dakota (NDGFD 2016b), the relatively low use and the low exposure index values, and the limited suitable foraging and nesting habitat available within the Project area (Derby et al. 2018), construction and operation of a wind facility is unlikely to have significant adverse impacts on golden eagle populations.

Waterfowl

Waterfowl accounted for the vast majority of overall large bird use in winter and spring, mainly due to several large groups of snow geese passing through. This species is abundant and a typical migrant in the North Dakota agricultural landscapes (NDGFD 2016c). The majority of waterfowl use occurred at Point 5, possibly due to the location of this point, within 0.6 mi (one km) of a large open water feature, and a mix of grassland and cropland vegetation that might provide additional foraging opportunities.

Based on available evidence, waterfowl do not seem especially vulnerable to turbine collisions. In an analysis of 116 bird mortality studies at over 70 facilities in North America, waterfowl made up 2.7% of 4,975 fatalities found (Erickson et al. 2014). Comparable studies in the Midwest indicated relatively low waterfowl fatalities. In southeast North Dakota, at the Tatanka Wind Farm where breeding waterfowl were studied, only one of the 46 fatalities documented was due to collision with a wind turbine (Gue et al. 2013). Similar findings were observed at the Buffalo Ridge Wind Energy Facility in southwestern Minnesota, an area with relatively high waterfowl use, where three of the 55 fatalities observed during the fatality monitoring studies included two mallards (*Anas platyrhynchos*) and one blue-winged teal (*Anas discors;* Johnson et al. 2002b). Based on the above information it seems unlikely that the wind facility would have a negative population-level impact on any waterfowl species.

SUMMARY

Currently, few published studies are available from the Midwest that correlate raptor use and mortality rates. Diurnal raptor use at the Project was similar to other facilities in North and South Dakota and lower than use levels recorded at other wind energy facilities in the central and western US. While use is intuitively related to raptor fatality risk to some degree, risk is likely influenced by other species-specific flying, breeding, and foraging behaviors. To date, overall fatality rates for diurnal raptors at wind energy facilities have been consistently low in the Midwest. Diurnal raptor fatality rates at the Project are expected to be within the range of fatality rates observed at other facilities where raptor use levels are comparable.

Both bald and golden eagles were observed during the one-year study conducted at the Project. However, given the relatively low use, low exposure index, and limited suitable foraging and nesting habitat available within the Project area for both eagle species, construction and operation of a wind facility is unlikely to have significant adverse impacts on golden or bald eagle populations.

No federally endangered, threatened, or proposed species were observed during large bird use surveys or incidentally. Fourteen sensitive species, all considered North Dakota SCP, were recorded during large bird use surveys. Of the species recorded, the bald and golden eagles are both protected under BGEPA. Additionally, the bald eagle is considered a USFWS BCC; along with the chestnut-collared longspur, marbled godwit, Sprague's pipit, Swainson's hawk, and upland sandpiper.

REFERENCES

16 United States Code (USC) § 668. 1940. Title 16 - Conservation; Chapter 5a - Protection and Conservation of Wildlife; Subchapter Ii - Protection of Bald and Golden Eagles; Section (§) 668 - Bald and Golden Eagles. 16 USC 668. [June 8, 1940, Chapter (Ch.) 278, Section (§) 1,54 Statute (Stat.) 250; Public Law (Pub. L.) 86–70, § 14, June 25, 1959, 73 Stat. 143; Pub. L. 87–884, October 24, 1962, 76 Stat. 1246; Pub. L. 92–535, § 1,October 23, 1972, 86 Stat. 1064].

Anderson, R., D. Strickland, J. Tom, N. Neumann, W. Erickson, J. Cleckler, G. Mayorga, G. Nuhn, A. Leuders, J. Schneider, L. Backus, P. Becker, and N. Flagg. 2000. Avian Monitoring and Risk Assessment at Tehachapi Pass and San Gorgonio Pass Wind Resource Areas, California: Phase 1 Preliminary Results. *In*: Proceedings of the National Avian Wind Power Planning Meeting III (PNAWPPM-III), May 1998, San Diego, California. National Wind Coordinating Collaborative (NWCC)/RESOLVE, Washington, D.C. Pp 31-46.

BHE Environmental, Inc. (BHE). 2010. Post-Construction Bird and Bat Mortality Study: Cedar Ridge Wind Farm, Fond Du Lac County, Wisconsin. Interim Report prepared for Wisconsin Power and Light, Madison, Wisconsin. Prepared by BHE Environmental, Inc. Cincinnati, Ohio. February 2010.

BHE Environmental, Inc. (BHE). 2011. Post-Construction Bird and Bat Mortality Study: Cedar Ridge Wind Farm, Fond Du Lac County, Wisconsin. Final Report. Prepared for Wisconsin Power and Light, Madison, Wisconsin. Prepared by BHE Environmental, Inc. Cincinnati, Ohio. February 2011.

Bureau of Land Management (BLM). 2006. Final Environmental Impact Statement for the Proposed Cotterel Wind Power Project and Proposed Resource Management Plan Amendment. FES 06-07. Serial No. IDI-33676. Prepared for the US Department of the Interior (USDOI), BLM, Twin Falls District, Burley Field Office, Cassia County, Idaho, on behalf of Windland, Inc., Boise, Idaho, and Shell WindEnergy Inc., Houston, Texas. March 2006.

Chatfield, A., W. P. Erickson, and K. Bay. 2010. Avian Baseline Studies at the Sun Creek Wind Resource Area, Kern County, California. Final Report: May 2009 - May 2010. Prepared for CH2M HILL, Oakland, California. Prepared by Western EcoSystems Technology, Inc., Cheyenne, Wyoming. September 30, 2010.

Chatfield, A., W. P. Erickson, and K. Bay. 2011. Avian Baseline Studies at the Alta East Wind Resource Area, Kern County, California. Final Report: July 10, 2010 - June 1, 2011. Prepared for CH2M HILL, Oakland, California. Prepared by Western EcoSystems Technology, Inc., Cheyenne, Wyoming. July 13, 2011. Appendix D-8. *In:* Bureau of Land Management (BLM). 2013. Alta East Wind Project: Proposed Plan Amendment and Final Environmental Impact Statement. CACA #0052537. US Department of the Interior BLM. February 2013. Available online: http://www.blm.gov/ca/st/en/fo/ridgecrest/alta_east_wind_project.html; 2011 Avian Baseline Report (Appendix D-8) available online at: http://www.blm.gov/pgdata/etc/medialib/blm/ca/pdf/ridgecrest/alta_east_wind.Par.22191.File.dat/D8%20Avian%20Baseline%20Studies%202011.pdf

Chodachek, K., C. Derby, M. Sonnenberg, and T. Thorn. 2012. Post-Construction Fatality Surveys for the Pioneer Prairie Wind Farm I Llc Phase Ii, Mitchell County, Iowa: April 4, 2011 – March 31, 2012. Prepared for EDP Renewables, North America LLC, Houston, Texas. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. August 27, 2012.

Derby, C., A. Dahl, W. Erickson, K. Bay, and J. Hoban. 2007. Post-Construction Monitoring Report for Avian and Bat Mortality at the Nppd Ainsworth Wind Farm. Unpublished report prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, for the Nebraska Public Power District.

Derby, C., A. Dahl, K. Taylor, K. Bay, and K. Seginak. 2008. Wildlife Baseline Studies for the Wessington Springs Wind Resource Area, Jerauld County, South Dakota, March 2007-November 2007. Technical report prepared for Power Engineers, Inc. and Babcock and Brown Renewable Holdings, Inc. by Western EcoSystems Technology, Inc. (WEST).

Derby, C. and A. Dahl. 2009. Wildlife Studies for the Bitter Root Wind Resource Area, Yellow, Medicine, and Lincoln Counties, Minnesota. Annual Report: March 25, 2008 - October 8, 2008. Prepared for Buffalo Ridge Power Partners, Argyle, New York. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismark, North Dakota. April 16, 2009. *In:* Minnesota Department of Commerce, Office of Energy Security. 2010. Bitter Root Wind Farm Project, Environmental Report. Site Permit Application, Appendix F. Minnesota Public Utilities Commission, Docket 25538. March 2010. April 16, 2009. Available online: http://www.calco.state.mn.us/commerce/energyfacilities/documents/25538/Appendix_%20F_Wildlife_Studies.pdf

Derby, C., K. Bay, and J. Ritzert. 2009. Bird Use Monitoring, Grand Ridge Wind Resource Area, La Salle County, Illinois. Year One Final Report, March 2008 - February 2009. Prepared for Grand Ridge Energy LLC, Chicago, Illinois. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. July 29, 2009.

Derby, C., J. Ritzert, and K. Bay. 2010a. Bird and Bat Fatality Study, Grand Ridge Wind Resource Area, Lasalle County, Illinois. January 2009 - January 2010. Prepared for Grand Ridge Energy LLC, Chicago, Illinois. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. July 13, 2010. Revised January 2011.

Derby, C., K. Bay, and A. Dahl. 2010b. Wildlife Baseline Studies for the Dempsey Wind Resource Area, Roger Mills County, Oklahoma. Final Report: March 2008 – February 2009. Prepared for HDR Engineering, Minneapolis, Minnesota, and Dempsey Ridge Wind Farm, LLC, a wholly owned subsidiary of Acciona Wind Energy USA LLC, Chicago, Illinois. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. February 10, 2010.

Derby, C., K. Bay, and A. Dahl. 2010c. Wildlife Baseline Studies for the Prairiewinds Sd1 Crow Lake Wind Resource Area, Aurora, Brule, and Jerauld Counties, South Dakota. Final Report: March 2009 - February 2010. Prepared for Basin Electric Power Cooperative, Bismarck, North Dakota. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. August 3, 2010.

Derby, C., A. Dahl, A. Merrill, and K. Bay. 2010d. 2009 Post-Construction Monitoring Results for the Wessington Springs Wind-Energy Facility, South Dakota. Final Report. Prepared for Wessington Wind Energy Center, LLC, Juno Beach, Florida. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. August 19, 2010.

Derby, C., K. Chodachek, K. Bay, and A. Merrill. 2010e. Post-Construction Fatality Survey for the Buffalo Ridge I Wind Project. May 2009 - May 2010. Prepared for Iberdrola Renewables, Inc., Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota.

Derby, C., K. Chodachek, K. Bay, and A. Merrill. 2010f. Post-Construction Fatality Surveys for the Elm Creek Wind Project: March 2009- February 2010. Prepared for Iberdrola Renewables, Inc. (IRI), Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota.

Derby, C., K. Chodachek, K. Bay, and A. Merrill. 2010g. Post-Construction Fatality Surveys for the Moraine Ii Wind Project: March - December 2009. Prepared for Iberdrola Renewables, Inc. (IRI), Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota.

Derby, C., K. Chodachek, K. Bay, and A. Merrill. 2010h. Post-Construction Fatality Surveys for the Winnebago Wind Project: March 2009- February 2010. Prepared for Iberdrola Renewables, Inc. (IRI), Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota.

Derby, C., A. Dahl, K. Bay, and L. McManus. 2011a. 2010 Post-Construction Monitoring Results for the Wessington Springs Wind Energy Facility, South Dakota. Final Report: March 9 – November 16, 2010. Prepared for Wessington Wind Energy Center, LLC, Juno Beach, Florida. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. November 22, 2011.

Derby, C., K. Chodachek, K. Bay, and S. Nomani. 2011b. Post-Construction Fatality Surveys for the Barton I and Ii Wind Project: Iri. March 2010 - February 2011. Prepared for Iberdrola Renewables, Inc. (IRI), Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. Version: September 28, 2011.

Derby, C., K. Chodachek, K. Bay, and S. Nomani. 2011c. Post-Construction Fatality Surveys for the Rugby Wind Project: Iberdrola Renewables, Inc. March 2010 - March 2011. Prepared for Iberdrola Renewables, Inc. (IRI), Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. Version: October 14, 2011.

Derby, C., K. Chodachek, T. Thorn, K. Bay, and S. Nomani. 2011d. Post-Construction Fatality Surveys for the Prairiewinds Nd1 Wind Facility, Basin Electric Power Cooperative, March - November 2010. Prepared for Basin Electric Power Cooperative, Bismarck, North Dakota. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. August 2, 2011.

Derby, C., K. Chodachek, and M. Sonnenberg. 2012a. Post-Construction Casualty Surveys for the Buffalo Ridge Ii Wind Project. Iberdrola Renewables: March 2011- February 2012. Prepared for Iberdrola Renewables, LLC, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. August 31, 2012.

Derby, C., K. Chodachek, and M. Sonnenberg. 2012b. Post-Construction Fatality Surveys for the Elm Creek Ii Wind Project. Iberdrola Renewables: March 2011-February 2012. Prepared for Iberdrola Renewables, LLC, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. October 8, 2012.

Derby, C., A. Dahl, and A. Merrill. 2012c. Post-Construction Monitoring Results for the Prairiewinds Sd1 Wind Energy Facility, South Dakota. Final Report: March 2011 - February 2012. Prepared for Basin Electric Power Cooperative, Bismarck, North Dakota. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. September 27, 2012.

Derby, C., K. Chodachek, T. Thorn, and A. Merrill. 2012d. Post-Construction Surveys for the Prairiewinds Nd1 (2011) Wind Facility Basin Electric Power Cooperative: March - October 2011. Prepared for Basin Electric Power Cooperative, Bismarck, North Dakota. Prepared by Western Ecosystems Technology, Inc. (WEST), Bismarck, North Dakota. August 31, 2012.

Derby, C., A. Dahl, and D. Fox. 2013. Post-Construction Fatality Monitoring Studies for the Prairiewinds Sd1 Wind Energy Facility, South Dakota. Final Report: March 2012 - February 2013. Prepared for Basin Electric Power Cooperative, Bismarck, North Dakota. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. November 13, 2013.

Derby, C. and T. Thorn. 2014. Avian Use Surveys for the Sunflower Wind Project, Morton and Stark Counties, North Dakota. Final Report: March 2013 through February 2014. Prepared for Sunflower Wind Project, LLC, Santa Barbara, California. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. May 22, 2014.

Derby, C., A. Dahl, and G. DiDonato. 2014. Post-Construction Fatality Monitoring Studies for the Prairiewinds Sd1 Wind Energy Facility, South Dakota. Final Report: March 2013 - February 2014. Prepared for Basin Electric Power Cooperative, Bismarck, North Dakota. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota.

Derby, C., S. Agudelo, and T. Thorn. 2018. 2017 Raptor Nest Survey Report, Emmons-Logan Wind Energy Center, Emmons and Logan Counties, North Dakota. Prepared for Emmons-Logan Wind, LLC. Prepared by Western EcoSystems Technology, Inc. (WEST). Bismarck, North Dakota. July 19, 2018.

Dyke, S. R., S. K. Johnson, and P. T. Isakson. 2015. North Dakota State Wildlife Action Plan. North Dakota Game and Fish Department, Bismarck, North Dakota. Available online: https://gf.nd.gov/wildlife/swap

Erickson, W., P. Rabie, K. Taylor, and K. Bay. 2014. Comparison of Avian Mortality Sources and Evaluation and Development of Compensatory Mitigation Options for Birds. Presented at the National Wind Coordinating Collaborative (NWCC), Wind Wildlife Research Meeting X, December 2-5, 2014, Broomfield, Colorado. Available online at: https://nationalwind.org/wp-content/uploads/2014/04/34_Erikson.pdf

Erickson, W. P., E. Lack, M. Bourassa, K. Sernka, and K. Kronner. 2001. Wildlife Baseline Study for the Nine Canyon Wind Project, Final Report May 2000-October 2001. Technical report prepared for Energy Northwest, Richland, Washington. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon.

Erickson, W. P., G. D. Johnson, K. Bay, and K. Kronner. 2002a. Ecological Baseline Study for the Zintel Canyon Wind Project. Final Report April 2001 – June 2002. Technical report prepared for Energy Northwest. Prepared for Energy Northwest by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon. June 2002.

Erickson, W. P., G. D. Johnson, D. P. Young, D. Strickland, R. Good, M. Bourassa, K. Bay, and K. Sernka. 2002b. Synthesis and Comparison of Baseline Avian and Bat Use, Raptor Nesting and Mortality Information from Proposed and Existing Wind Developments. Technical report prepared for Bonneville Power Administration, Portland, Oregon by WEST, Inc., Cheyenne, Wyoming. December 2002. http://www.bpa.gov/Power/pgc/wind/Avian_and_Bat_Study_12-2002.pdf

Erickson, W. P., K. Kronner, and R. Gritski. 2003a. Nine Canyon Wind Power Project Avian and Bat Monitoring Report. September 2002 – August 2003. Prepared for the Nine Canyon Technical Advisory Committee and Energy Northwest by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Northwest Wildlife Consultants (NWC), Pendleton, Oregon. October 2003. Available online at: http://www.west-inc.com/reports/nine_canyon_monitoring_final.pdf

Erickson, W. P., J. Jeffrey, K. Kronner, and K. Bay. 2003b. Stateline Wind Project Wildlife Monitoring Annual Report, Results for the Period July 2001 - December 2002. Technical report submitted to FPL Energy, the Oregon Office of Energy, and the Stateline Technical Advisory Committee. Western EcoSystems Technology, Inc., Cheyenne, Wyoming. May 2003.

Erickson, W. P., J. Jeffrey, D. P. Young, K. Bay, R. Good, K. Sernka, and K. Kronner. 2003c. Wildlife Baseline Study for the Kittitas Valley Wind Project: Summary of Results from 2002 Wildlife Surveys. Final Report: February 2002– November 2002. Prepared for Zilkha Renewable Energy, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon. January 2003.

Erickson, W. P., D. P. Young, G. D. Johnson, J. Jeffrey, K. Bay, R. Good, and H. Sawyer. 2003d. Wildlife Baseline Study for the Wild Horse Wind Project. Summary of Results from 2002-2003 Wildlife Surveys May 10, 2002- May 22, 2003. Prepared for Zilkha Renewable Energy, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. November 2003. Available online: http://www.efsec.wa.gov/wildhorse/apl/Exhibits%20PDF/E14-Ecological%20Baseline%20Study-%2011_20_03.pdf

Erickson, W. P., A. Chatfield, and K. Bay. 2011. Avian Baseline Studies for the North Sky River Wind Energy Project, Kern County, California. Final Report: May 18, 2010 – May 26, 2011. Final Report. Prepared for CH2M HILL, Portland Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. July 7, 2011.

ESRI. 2016. World Imagery and Aerial Photos. ArcGIS Resource Center. Environmental Systems Research Institute (ESRI), producers of ArcGIS software. Redlands, California.

Fagen Engineering, LLC. 2014. 2013 Avian and Bat Monitoring Annual Report: Big Blue Wind Farm, Blue Earth, Minnesota. Prepared for Big Blue Wind Farm. Prepared by Fagen Engineering, LLC. May 2014.

Fagen Engineering, LLC. 2015. 2014 Avian and Bat Monitoring Annual Report: Big Blue Wind Farm, Blue Earth, Minnesota. Prepared for Big Blue Wind Farm. Prepared by Fagen Engineering, LLC.

Ferrer, M., M. de Lucas, G. F. E. Janss, E. Casado, A. R. Munoz, M. J. Bechard, and C. P. Calabuig. 2011. Weak Relationship between Risk Assessment Studies and Recorded Mortality in Wind Farms. Journal of Applied Ecology: doi: 10.1111/j.1365-2664.2011.02054.x.

Good, R. E., M. Ritzert, and K. Bay. 2010. Wildlife Baseline Studies for the Timber Road Phase Ii Wind Resource Area, Paulding County, Ohio. Final Report: September 2, 2008 - August 19, 2009. Prepared for Horizon Wind Energy, Houston, Texas. Prepared by Western EcoSystems Technology, Inc. (WEST), Bloomington, Indiana. April 28, 2010.

Good, R. E., M. L. Ritzert, and K. Adachi. 2013. Post-Construction Monitoring at the Rail Splitter Wind Farm, Tazwell and Logan Counties, Illinois. Final Report: May 2012 - May 2013. Prepared for EDP Renewables, Houston, Texas. Prepared by Western EcoSystems Technology, Inc. (WEST), Bloomington, Indiana. December 16, 2013.

Gruver, J., M. Sonnenberg, K. Bay, and W. Erickson. 2009. Post-Construction Bat and Bird Fatality Study at the Blue Sky Green Field Wind Energy Center, Fond Du Lac County, Wisconsin July 21 - October 31, 2008 and March 15 - June 4, 2009. Unpublished report prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. December 17, 2009.

Gue, T., K. Mehl, B. Goodwin, J. Walker, S. Stephens, J. Gleason, C. Loesch, and R. Reynolds. 2013. The Effects of a Large Scale Wind Farm on Breeding Season Survival of Female Mallards and Blue-Winged Teal in the Prairie Pothole Region (Ppr). Presented at the National Wind Coordinating Collaborative (NWCC), Research Webinar. November 2013. Available online at: www.nationalwind.org/assets/webinars/NWCC_Webinar_GUE_2013pdf.pdf

Howe, R. W., W. Evans, and A. T. Wolf. 2002. Effects of Wind Turbines on Birds and Bats in Northeastern Wisconsin. Prepared by University of Wisconsin-Green Bay, for Wisconsin Public Service Corporation and Madison Gas and Electric Company, Madison, Wisconsin. November 21, 2002. 104 pp.

Jacques Whitford Stantec Limited (Jacques Whitford). 2009. Ripley Wind Power Project Postconstruction Monitoring Report. Project No. 1037529.01. Report to Suncor Energy Products Inc., Calgary, Alberta, and Acciona Energy Products Inc., Calgary, Alberta. Prepared for the Ripley Wind Power Project Post-Construction Monitoring Program. Prepared by Jacques Whitford, Markham, Ontario. April 30, 2009.

Jain, A. 2005. Bird and Bat Behavior and Mortality at a Northern Iowa Windfarm. Iowa State University, Ames, Iowa.

Jeffrey, J. D., V. K. Poulton, K. J. Bay, K. F. Flaig, C. C. Roderick, W. P. Erickson, and J. E. Baker. 2007. Wildlife and Habitat Baseline Study for the Proposed Vantage Wind Power Project, Kittitas County, Washington. Final Report. Prepared for Invenergy. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Walla Walla, Washington. August 2007. Available online: https://www.co.kittitas.wa.us/uploads/cds/land-use/Wind%20Farm/WSA-07-01%20Vantage%20Wind%20%20Power%20Project%20Application/VANTAGE_WILDLIFE_BASELINE%20REPORT_8.27.07.pdf

Jeffrey, J. D., W. P. Erickson, K. J. Bay, V. K. Poulton, W. L. Tidhar, and J. E. Baker. 2008. Wildlife Baseline Studies for the Golden Hills Wind Resource Area, Sherman County, Oregon. Final Report May 2006 – October 2007. Prepared for BP Alternative Energy North America Inc., Houston, Texas, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming.

Johnson, G. D., W. P. Erickson, M. D. Strickland, M. F. Shepherd, and D. A. Shepherd. 2000a. Final Report: Avian Monitoring Studies at the Buffalo Ridge Wind Resource Area, Minnesota: Results of a 4-Year Study. Final report prepared for Northern States Power Company, Minneapolis, Minnesota, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. September 22, 2000. 212 pp.

Johnson, G. D., D. P. Young, W. P. Erickson, C. E. Derby, M. D. Strickland, R. E. Good, and J. W. Kern. 2000b. Final Report: Wildlife Monitoring Studies, Seawest Windpower Project, Carbon County, Wyoming, 1995-1999. Final report prepared for SeaWest Energy Corporation, San Diego, California, and the Bureau of Land Management, Rawlins, Wyoming, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. August 9, 2000.

Johnson, G. D., W. P. Erickson, K. Bay, and K. Kronner. 2002a. Baseline Ecological Studies for the Klondike Wind Project, Sherman County, Oregon. Final report prepared for Northwestern Wind Power, Goldendale, Washington. Prepared by Western EcoSystems Technology, Inc. (WEST) Cheyenne, Wyoming, and Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon. May 29, 2002. Available online: http://wind.nrel.gov/public/library/johnson5.pdf

Johnson, G. D., W. P. Erickson, M. D. Strickland, M. F. Shepherd, D. A. Shepherd, and S. A. Sarappo. 2002b. Collision Mortality of Local and Migrant Birds at a Large-Scale Wind-Power Development on Buffalo Ridge, Minnesota. Wildlife Society Bulletin 30(3): 879-887.

Johnson, G. D., J. Jeffrey, J. Baker, and K. Bay. 2007. Baseline Avian Studies for the Windy Flats Wind Energy Project, Klickitat County, Washington. Prepared for Windy Point Partners, LLC. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. May 29, 2007. Available online: http://www.efsec.wa.gov/Whistling%20Ridge/Adjudication/Cross%20Exhibits/06.06C%20Windy%20Flats-Environmental%20Report%20Excerpt.pdf

Johnson, G. D., K. Bay, and J. Eddy. 2009a. Wildlife Baseline Studies for the Dunlap Ranch Wind Resource Area, Carbon and Albany Counties, Wyoming. June 4, 2008 - May 27, 2009. Prepared for CH2M HILL, Englewood, Colorado. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. July 25, 2009. Available online at: http://amlportal.state.wy.us/out/downloads/Dunlap%20Addendum4.pdf

Johnson, G. D., K. Bay, and J. Eddy. 2009b. Wildlife Baseline Studies for the High Plains Wind Resource Area, Carbon and Albany Counties, Wyoming. Prepared for CH2M HILL. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming.

Johnson, G. D., M. Ritzert, S. Nomani, and K. Bay. 2010. Bird and Bat Fatality Studies, Fowler Ridge I Wind-Energy Facility Benton County, Indiana. Unpublished report prepared for British Petroleum Wind Energy North America Inc. (BPWENA) by Western EcoSystems Technology, Inc. (WEST).

Kerlinger, P., L. Culp, and R. Curry. 2005. Post-Construction Avian Monitoring Study for the High Winds Wind Power Project, Solano County, California. Year One Report. Prepared for High Winds, LLC and FPL Energy.

Kronner, K., R. Gritski, J. Baker, V. Marr, G. Johnson, and K. Bay. 2005. Wildlife Baseline Study for the Leaning Juniper Wind Power Project, Gilliam County, Oregon. Prepared by Northwest Wildlife Consultants, Inc. (NWC) and Western Ecosystems Technology, Inc. (WEST). Prepared for PPM Energy, Portland, Oregon and CH2M HILL, Portland, Oregon by NWC, Pendleton, Oregon, and WEST, Cheyenne, Wyoming. November 3, 2005.

North Dakota Game and Fish Department (NDGFD). 2016a. Bald Eagle Fact Sheet. Accessed May 2, 2018. Available online: https://gf.nd.gov/wildlife/id/raptors/bald-eagle

North Dakota Game and Fish Department (NDGFD). 2016b. Golden Eagle. Wildlife and Conservation. Species Identification. North Dakota Raptors. Available online: https://gf.nd.gov/wildlife/id/raptors/golden-eagle

North Dakota Game and Fish Department (NDGFD). 2016c. Lesser Snow Goose (and Ross' Goose). Wildlife and Conservation. Species Identification. North Dakota Waterfowl Identification. Available online: https://gf.nd.gov/wildlife/id/waterfowl/lesser-snow-goose

Northwest Wildlife Consultants, Inc. (NWC) and Western Ecosystems Technology, Inc. (WEST). 2004. Ecological Baseline Studies for the Roosevelt Wind Project, Klickitat County, Washington. Final Report. Prepared by NWC, Pendleton, Oregon, and WEST, Inc., Cheyenne, Wyoming. September 2004.

Northwest Wildlife Consultants, Inc. (NWC), and Western EcoSystems Technology, Inc. (WEST). 2005. Ecological Baseline Studies and Wildlife Impact Assessment for the White Creek Wind Power Project, Klickitat County, Washington. Prepared for Last Mile Electric Cooperative, Goldendale, Washington. Prepared by K. Kronner, R. Gritski, and J. Baker, NWC, Goldendale, Washington, and G.D. Johnson, K. Bay, R.Good, and E. Lack, WEST, Cheyenne Wyoming. January 12, 2005.

Orloff, S. and A. Flannery. 1992. Wind Turbine Effects on Avian Activity, Habitat Use, and Mortality in Altamont Pass and Solano County Wind Resource Areas, 1989-1991. Final Report P700-92-001 to Alameda, Contra Costa, and Solano Counties, and the California Energy Commission, Sacramento, California, by Biosystems Analysis, Inc., Tiburon, California. March 1992.

Pagel, J. E., K. J. Kritz, B. A. Millsap, R. K. Murphy, E. L. Kershner, and S. Covington. 2013. Bald Eagle and Golden Eagle Mortalities at Wind Energy Facilities in the Contiguous United States. Journal of Raptor Research 47(3): 311-315.

Public Law (Pub. L.) 93-205. 1973. Endangered Species Act of 1973. Public Law (PL) 93-205; 87 Stat.: 884-902. December 28, 1973.

Reynolds, R. T., J. M. Scott, and R. A. Nussbaum. 1980. A Variable Circular-Plot Method for Estimating Bird Numbers. Condor 82(3): 309-313.

URS Corporation, Western EcoSystems Technology, Inc. (WEST), and Northwest Wildlife Consultants, Inc. (NWC). 2001. Avian Baseline Study for the Stateline Project. Prepared for FPL Energy Vansycle, LLC, Juno Beach, Florida.

US Environmental Protection Agency (USEPA). 2017. Level Iii and Level Iv Ecoregions of the Continental United States. Ecosystems Research, USEPA. Last updated February 8, 2017. Information and maps online: https://www.epa.gov/eco-research/level-iii-and-iv-ecoregions-continental-united-states

US Fish and Wildlife Service (USFWS). 2008. Birds of Conservation Concern 2008. December 2008. Division of Migratory Bird Management, Arlington, Virginia. Available online: https://www.fws.gov/migratorybirds/pdf/grants/BirdsofConservationConcern2008.pdf

US Fish and Wildlife Service (USFWS). 2012. Land-Based Wind Energy Guidelines. March 23, 2012. 82 pp. Available online: http://www.fws.gov/cno/pdf/Energy/2012_Wind_Energy_Guidelines_final.pdf

US Fish and Wildlife Service (USFWS). 2013. Eagle Conservation Plan Guidance: Module 1 - Land-Based Wind Energy, Version 2. US Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management. April 2013. Executive Summary and frontmatter + 103 pp. Available online: https://www.fws.gov/migratorybirds/pdf/management/eagleconservationplanguidance.pdf

USA Topo. 2013. USA Topo Maps. US Geological Survey (USGS) topographical maps for the United States. ArcGIS. ESRI, producers of ArcGIS software. Redlands, California.

Western EcoSystems Technology, Inc. (WEST). 2005a. Ecological Baseline Study at the Elkhorn Wind Power Project. Exhibit A. Final report prepared for Zilkha Renewable Energy, LLC, Portland, Oregon, by WEST, Cheyenne, Wyoming. June 2005.

Western EcoSystems Technology, Inc. (WEST). 2005b. Ecological Baseline Study for the Proposed Reardan Wind Project, Lincoln County, Washington. Draft Final Report. Prepared for Energy Northwest, Richland, Washington, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. June 2005.

Western EcoSystems Technology, Inc. (WEST). 2005c. Wildlife and Habitat Baseline Study for the Proposed Biglow Canyon Wind Power Project, Sherman County, Oregon. March 2004 - August 2005. Prepared for Orion Energy LLC., Oakland, California. WEST, Cheyenne, Wyoming. October, 2005.

Western EcoSystems Technology, Inc. (WEST). 2006. Diablo Winds Wildlife Monitoring Progress Report, March 2005 - February 2006. Technical report submitted to FPL Energy and Alameda County California. WEST, Cheyenne, Wyoming.

Western EcoSystems Technology, Inc. (WEST) and the Colorado Plateau Research Station (CPRS). 2006. Avian Studies for the Proposed Sunshine Wind Park, Coconino County, Arizona. Prepared for Sunshine Arizona Wind Energy, LLC., Flagstaff, Arizona, by WEST, Cheyenne, Wyoming, and the CPRS. Ecological Monitoring and Assessment Program, Northern Arizona University, Flagstaff, Arizona. May 2006.

Western EcoSystems Technology, Inc. (WEST). 2009. Wildlife Baseline Studies for the Antelope Ridge Wind Resource Area, Union County, Oregon. August 28, 2008 - August 12, 2009. Draft final report prepared for Horizon Wind Energy, Houston, Texas. Prepared by WEST, Cheyenne, Wyoming.

Young, D.P., Jr., W. P. Erickson, K. Bay, and R. Good. 2002. Baseline Avian Studies for the Proposed Maiden Wind Farm, Yakima and Benton Counties, Washington. Final Report, April 2001-April 2002. Prepared for Bonneville Power Administration, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon. November 20, 2002. Available online at: http://west-inc.com/reports/maiden_final_technical.pdf

Young, D.P., Jr., W. P. Erickson, J. Jeffrey, K. Bay, R. E. Good, and E. G. Lack. 2003a. Avian and Sensitive Species Baseline Study Plan and Final Report. Eurus Combine Hills Turbine Ranch, Umatilla County, Oregon. Technical report prepared for Eurus Energy America Corporation, San Diego, California and Aeropower Services, Inc., Portland, Oregon, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. March 10, 2003.

Young, D.P., Jr., W. P. Erickson, K. Bay, J. Jeffrey, E. G. Lack, and H. H. Sawyer. 2003b. Baseline Avian Studies for the Proposed Desert Claim Wind Power Project, Kittitas County, Washington. Final Report. Prepared for Desert Claim Wind Power, LLC, Ellensburg, Washington, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. July 2003.

Young, D.P., Jr., W. P. Erickson, K. Bay, J. Jeffrey, E. G. Lack, R. E. Good, and H. H. Sawyer. 2003c. Baseline Avian Studies for the Proposed Hopkins Ridge Wind Project, Columbia County, Washington. Final Report: March 2002 - March 2003. Prepared for RES North America, LLC, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. April 30, 2003. Available online at: http://wind.nrel.gov/public/library/young5.pdf

Young, D.P., Jr., V. K. Poulton, and K. Bay. 2007a. Ecological Baseline Studies Report. Proposed Dry Lake Wind Project, Navajo County, Arizona. Prepared for PPM Energy, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. July 1, 2007. Available online at: http://www.blm.gov/style/medialib/blm/az/pdfs/energy/dry-lake.Par.83529.File.dat/AppC-eco_baseline_study.pdf

Young, D.P., Jr., G. D. Johnson, V. K. Poulton, and K. Bay. 2007b. Ecological Baseline Studies for the Hatchet Ridge Wind Energy Project, Shasta County, California. Prepared for Hatchet Ridge Wind, LLC, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. August 31, 2007. Available online from: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentVersionID=41939

Appendix A. All Bird Types, Diurnal Raptor Subtypes, and Species Observed During the Large Bird Use Surveys Conducted within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan Counties, North Dakota, from April 4, 2017 – March 27, 2018.

Appendix A. Summary number (#) of groups (Grps) and individual observations (Obs) by major large bird type, raptor subtype, and species, observed during the large bird use surveys conducted within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan counties, North Dakota, from April 4, 2017 – March 27, 2018.

		Spring		Summer		Fall		Winter		Total	
Bird Type/Subtype/Species	Scientific Name	# Grps	# Obs	# Grps	# Obs	# Grps	# Obs	# Grps	# Obs	# Grps	# Obs
Waterbirds		**14**	**483**	**1**	**1**	**2**	**85**	**0**	**0**	**17**	**569**
American white pelican	*Pelecanus erythrorhynchos*	0	0	0	0	1	65	0	0	1	65
double-crested cormorant	*Phalacrocorax auritus*	0	0	1	1	0	0	0	0	1	1
great blue heron	*Ardea herodias*	1	1	0	0	0	0	0	0	1	1
sandhill crane	*Antigone canadensis*	13	482	0	0	1	20	0	0	14	502
Waterfowl		**17**	**1,718**	**0**	**0**	**2**	**295**	**10**	**12,508**	**29**	**14,521**
blue-winged teal	*Anas discors*	3	6	0	0	0	0	0	0	3	6
Canada goose	*Branta canadensis*	1	18	0	0	0	0	0	0	1	18
greater white-fronted goose	*Anser albifrons*	0	0	0	0	1	45	0	0	1	45
mallard	*Anas platyrhynchos*	2	4	0	0	0	0	0	0	2	4
northern pintail	*Anas acuta*	4	8	0	0	0	0	0	0	4	8
northern shoveler	*Anas clypeata*	3	12	0	0	0	0	0	0	3	12
snow goose	*Chen caerulescens*	3	1,640	0	0	1	250	10	12,508	14	14,398
unidentified puddle duck	*Anas spp.*	1	30	0	0	0	0	0	0	1	30
Shorebirds		**1**	**1**	**8**	**9**	**0**	**0**	**0**	**0**	**9**	**10**
killdeer	*Charadrius vociferus*	0	0	1	1	0	0	0	0	1	1
marbled godwit	*Limosa fedoa*	1	1	2	2	0	0	0	0	3	3
upland sandpiper	*Bartramia longicauda*	0	0	5	6	0	0	0	0	5	6
Gulls/Terns		**0**	**0**	**1**	**25**	**0**	**0**	**0**	**0**	**1**	**25**
ring-billed gull	*Larus delawarensis*	0	0	1	25	0	0	0	0	1	25
Diurnal Raptors		**17**	**18**	**20**	**20**	**22**	**22**	**6**	**6**	**65**	**66**
Accipiters		*0*	*0*	*0*	*0*	*1*	*1*	*0*	*0*	*1*	*1*
Cooper's hawk	*Accipiter cooperii*	0	0	0	0	1	1	0	0	1	1
Buteos		*7*	*7*	*15*	*15*	*13*	*13*	*0*	*0*	*35*	*35*
red-tailed hawk	*Buteo jamaicensis*	3	3	11	11	5	5	0	0	19	19
Swainson's hawk	*Buteo swainsoni*	3	3	4	4	8	8	0	0	15	15
unidentified buteo	*Buteo spp*	1	1	0	0	0	0	0	0	1	1
Northern Harrier		*8*	*9*	*5*	*5*	*8*	*8*	*0*	*0*	*21*	*22*
northern harrier	*Circus cyaneus*	8	9	5	5	8	8	0	0	21	22
Eagles		*0*	*0*	*0*	*0*	*0*	*0*	*2*	*2*	*2*	*2*
bald eagle	*Haliaeetus leucocephalus*	0	0	0	0	0	0	1	1	1	1
golden eagle	*Aquila chrysaetos*	0	0	0	0	0	0	1	1	1	1
Falcons		*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1*
merlin	*Falco columbarius*	1	1	0	0	0	0	0	0	1	1

Appendix A. Summary number (#) of groups (Grps) and individual observations (Obs) by major large bird type, raptor subtype, and species, observed during the large bird use surveys conducted within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan counties, North Dakota, from April 4, 2017 – March 27, 2018.

		Spring		Summer		Fall		Winter		Total	
Bird Type/Subtype/Species	Scientific Name	# Grps	# Obs	# Grps	# Obs	# Grps	# Obs	# Grps	# Obs	# Grps	# Obs
Other Raptors		*1*	*1*	*0*	*0*	*0*	*0*	*4*	*4*	*5*	*5*
unidentified raptor	*NA*	1	1	0	0	0	0	4	4	5	5
Vultures		**1**	**1**	**2**	**2**	**0**	**0**	**0**	**0**	**3**	**3**
turkey vulture	*Cathartes aura*	1	1	2	2	0	0	0	0	3	3
Upland Game Birds		**5**	**5**	**4**	**4**	**1**	**3**	**0**	**0**	**10**	**12**
ring-necked pheasant	*Phasianus colchicus*	5	5	4	4	0	0	0	0	9	9
sharp-tailed grouse	*Tympanuchus phasianellus*	0	0	0	0	1	3	0	0	1	3
Doves/Pigeons		**5**	**13**	**3**	**5**	**0**	**0**	**0**	**0**	**8**	**18**
mourning dove	*Zenaida macroura*	4	7	3	5	0	0	0	0	7	12
rock pigeon	*Columba livia*	1	6	0	0	0	0	0	0	1	6
Large Corvids		**2**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**2**
American crow	*Corvus brachyrhynchos*	2	2	0	0	0	0	0	0	2	2
Large Birds Overall		**62**	**2,241**	**39**	**66**	**27**	**405**	**16**	**12,514**	**144**	**15,226**

[a] Regardless of distance from observer.

Appendix B. Mean Use, Percent of Use, and Frequency of Occurrence for Large Birds Observed During Large Bird Use Surveys Conducted within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan Counties, North Dakota, from April 4, 2017 – March 27, 2018.

Appendix B. Mean bird use (number of birds/plot/survey)[a], percent of total use, and frequency of occurrence by major large bird type, raptor subtype, and season, observed during the 60-minute (min) large bird use surveys conducted within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan counties, North Dakota, from April 4, 2017 – March 27, 2018.

	Mean Use				Percent of Use (%)				Frequency of Occurrence (%)			
Bird Type/Subtype/Species	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**
Waterbirds	**7.00**	**0.02**	**1.85**	**0**	**12.8**	**1.7**	**21.0**	**0**	**5.8**	**1.7**	**4.3**	**0**
American white pelican	0	0	1.41	0	0	0	16.0	0	0	0	2.2	0
double-crested cormorant	0	0.02	0	0	0	1.7	0	0	0	1.7	0	0
great blue heron	0.01	0	0	0	<0.1	0	0	0	1.4	0	0	0
sandhill crane	6.99	0	0.43	0	12.8	0	4.9	0	4.3	0	2.2	0
Waterfowl	**46.93**	**0**	**6.41**	**135.96**	**86.1**	**0**	**72.8**	**99.9**	**17.1**	**0**	**4.3**	**4.3**
blue-winged teal	0.09	0	0	0	0.2	0	0	0	4.3	0	0	0
Canada goose	0.50	0	0	0	0.9	0	0	0	2.8	0	0	0
greater white-fronted goose	0	0	0.98	0	0	0	11.1	0	0	0	2.2	0
mallard	0.06	0	0	0	0.1	0	0	0	2.9	0	0	0
northern pintail	0.12	0	0	0	0.2	0	0	0	5.8	0	0	0
northern shoveler	0.17	0	0	0	0.3	0	0	0	4.3	0	0	0
snow goose	45.56	0	5.43	135.96	83.6	0	61.7	99.9	5.6	0	2.2	4.3
unidentified puddle duck	0.43	0	0	0	0.8	0	0	0	1.4	0	0	0
Shorebirds	**0.01**	**0.13**	**0**	**0**	**<0.1**	**13.4**	**0**	**0**	**1.4**	**8.9**	**0**	**0**
killdeer	0	0.01	0	0	0	1.4	0	0	0	1.4	0	0
marbled godwit	0.01	0.03	0	0	<0.1	3.3	0	0	1.4	1.7	0	0
upland sandpiper	0	0.09	0	0	0	8.7	0	0	0	7.2	0	0
Gulls/Terns	**0**	**0.38**	**0**	**0**	**0**	**37.8**	**0**	**0**	**0**	**1.5**	**0**	**0**
ring-billed gull	0	0.38	0	0	0	37.8	0	0	0	1.5	0	0
Diurnal Raptors	**0.23**	**0.31**	**0.48**	**0.07**	**0.4**	**31.0**	**5.4**	**<0.1**	**21.7**	**28.1**	**28.3**	**6.9**
Accipiters	*0*	*0*	*0.02*	*0*	*0*	*0*	*0.2*	*0*	*0*	*0*	*2.2*	*0*
Cooper's hawk	0	0	0.02	0	0	0	0.2	0	0	0	2.2	0
Buteos	*0.09*	*0.23*	*0.28*	*0*	*0.2*	*23.3*	*3.2*	*0*	*8.7*	*21.9*	*21.7*	*0*
red-tailed hawk	0.04	0.17	0.11	0	<0.1	17.0	1.2	0	4.3	15.6	10.9	0
Swainson's hawk	0.04	0.06	0.17	0	<0.1	6.3	2.0	0	4.3	6.3	13	0
Northern Harrier	*0.13*	*0.08*	*0.17*	*0*	*0.2*	*7.7*	*2.0*	*0*	*11.6*	*7.7*	*15.2*	*0*
northern harrier	0.13	0.08	0.17	0	0.2	7.7	2.0	0	11.6	7.7	15.2	0
Eagles	*0*	*0*	*0*	*0.02*	*0*	*0*	*0*	*<0.1*	*0*	*0*	*0*	*2.2*
bald eagle	0	0	0	0.01	0	0	0	<0.1	0	0	0	1.1
golden eagle	0	0	0	0.01	0	0	0	<0.1	0	0	0	1.1
Falcons	*0.01*	*0*	*0*	*0*	*<0.1*	*0*	*0*	*0*	*1.4*	*0*	*0*	*0*
merlin	0.01	0	0	0	<0.1	0	0	0	1.4	0	0	0
Other Raptors	*0*	*0*	*0*	*0.05*	*0*	*0*	*0*	*<0.1*	*0*	*0*	*0*	*4.7*

Appendix B. Mean bird use (number of birds/plot/survey)[a], percent of total use, and frequency of occurrence by major large bird type, raptor subtype, and season, observed during the 60-minute (min) large bird use surveys conducted within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan counties, North Dakota, from April 4, 2017 – March 27, 2018.

	Mean Use				Percent of Use (%)				Frequency of Occurrence (%)			
Bird Type/Subtype/Species	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**
unidentified raptor	0	0	0	0.05	0	0	0	<0.1	0	0	0	4.7
Vultures	**0.01**	**0.03**	**0**	**0**	**<0.1**	**3.1**	**0**	**0**	**1.4**	**3.1**	**0**	**0**
turkey vulture	0.01	0.03	0	0	<0.1	3.1	0	0	1.4	3.1	0	0
Upland Game Birds	**0.07**	**0.06**	**0.07**	**0**	**0.1**	**5.8**	**0.7**	**0**	**7.2**	**5.8**	**2.2**	**0**
ring-necked pheasant	0.07	0.06	0	0	0.1	5.8	0	0	7.2	5.8	0	0
sharp-tailed grouse	0	0	0.07	0	0	0	0.7	0	0	0	2.2	0
Doves/Pigeons	**0.19**	**0.07**	**0**	**0**	**0.3**	**7.2**	**0**	**0**	**5.8**	**2.9**	**0**	**0**
mourning dove	0.10	0.07	0	0	0.2	7.2	0	0	5.8	2.9	0	0
rock pigeon	0.09	0	0	0	0.2	0	0	0	1.4	0	0	0
Large Corvids	**0.03**	**0**	**0**	**0**	**<0.1**	**0**	**0**	**0**	**2.9**	**0**	**0**	**0**
American crow	0.03	0	0	0	<0.1	0	0	0	2.9	0	0	0
Large Birds Overall	**54.48**	**1.00**	**8.80**	**136.03**	**100**	**100**	**100**	**100**				

[a] 2,624.7-foot (800.0-meter) radius survey plot; 60-minute survey.

Appendix C. Flight Height Characteristics and Species Collision Risk Exposure Indices for Large Birds Observed During Large Bird Use Surveys Conducted within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan Counties, North Dakota, from April 4, 2017 – March 27, 2018.

Appendix C. Relative collision risk exposure index[a] and flight characteristics for each large bird species observed during the 60-minute large bird use surveys[b] conducted within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan counties, North Dakota, from April 14, 2017 – March 22, 2018.

Species	Number of Groups Flying	Overall Mean Use	Percent Flying (%)	Percent Flying Within RSH[c] Based on Initial Observation (%)	Exposure Index	Percent Within RSH at Any Time (%)
snow goose	14	52.8	100	77.8	41.07	77.8
American white pelican	1	0.28	100	100	0.28	100
ring-billed gull	1	0.10	100	100	0.10	100
red-tailed hawk	14	0.08	73.7	92.9	0.05	92.9
Swainson's hawk	9	0.06	60.0	44.4	0.02	77.8
northern harrier	20	0.09	95.5	19.0	0.02	19.0
turkey vulture	3	0.01	100	66.7	<0.01	66.7
double-crested cormorant	1	<0.01	100	100	<0.01	100
golden eagle	1	<0.01	100	100	<0.01	100
bald eagle	1	<0.01	100	100	<0.01	100
sandhill crane	10	1.85	79.1	0	0	0
greater white-fronted goose	1	0.20	100	0	0	0
Canada goose	1	0.13	100	0	0	0
unidentified puddle duck	0	0.11	0	0	0	0
northern shoveler	2	0.04	83.3	0	0	80.0
mourning dove	3	0.04	33.3	0	0	0
ring-necked pheasant	0	0.03	0	0	0	0
northern pintail	3	0.03	75.0	0	0	0
upland sandpiper	0	0.02	0	0	0	0
rock pigeon	1	0.02	100	0	0	100
blue-winged teal	1	0.02	33.3	0	0	0
mallard	1	0.01	50.0	0	0	0
unidentified raptor	4	0.01	100	0	0	0
sharp-tailed grouse	1	0.01	100	0	0	0
marbled godwit	3	0.01	100	0	0	0
American crow	1	<0.01	50.0	0	0	100
Cooper's hawk	1	<0.01	100	0	0	0
merlin	0	<0.01	0	0	0	0
killdeer	1	<0.01	100	0	0	0
great blue heron	0	<0.01	0	0	0	0

[a] Based on flight characteristics when first observed. Only observations first recorded as flying were included in this analysis.

[b.] 2,625-foot (ft; 800-meter [m]) radius survey plot for large birds.

[c.] The likely “rotor-swept height” for potential collision with a turbine blade, or 82–492 ft (25–150 m) above ground level.

Appendix D. Mean Use by Point for All Large Birds, Major Bird Types, and Raptor Subtypes Observed During Large Bird Use Surveys Conducted within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan Counties, North Dakota, from April 4, 2017 – March 27, 2018.

Appendix D. Mean use (number of birds/60-minute survey) by point[a] for all major large bird types and diurnal raptor subtypes observed during large bird use surveys conducted within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan counties, North Dakota, from April 4, 2017 – March 27, 2018.

	Survey Point											
Bird Type	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Waterbirds	**0**	**0**	**0**	**0**	**5.17**	**0**	**0**	**0**	**0**	**0**	**0.08**	**0**
Waterfowl	**0**	**0**	**0**	**0**	**883.33**	**0.20**	**4.50**	**0**	**0**	**0**	**2.83**	**0**
Shorebirds	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.08**	**0**
Gulls/Terns	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Diurnal Raptors	**0.12**	**0.25**	**0.42**	**0.25**	**0.33**	**0.20**	**0.58**	**0.14**	**0.17**	**0.88**	**0.17**	**0.43**
Accipiters	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0.12*	*0*	*0*
Buteos	*0.12*	*0.12*	*0.33*	*0.25*	*0.17*	*0.10*	*0.33*	*0*	*0*	*0.25*	*0.08*	*0.14*
Northern Harrier	*0*	*0.12*	*0.08*	*0*	*0.08*	*0.10*	*0.17*	*0*	*0*	*0.50*	*0.08*	*0.29*
Eagles	*0*	*0*	*0*	*0*	*0.08*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Falcons	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0.14*	*0*	*0*	*0*	*0*
Other Raptors	*0*	*0*	*0*	*0*	*0*	*0*	*0.08*	*0*	*0.17*	*0*	*0*	*0*
Vultures	**0**	**0.12**	**0**	**0**	**0**	**0.10**	**0**	**0**	**0.08**	**0**	**0**	**0**
Upland Game Birds	**0**	**0**	**0**	**0**	**0**	**0**	**0.25**	**0.14**	**0**	**0.12**	**0.08**	**0.29**
Doves/Pigeons	**0**	**0**	**0**	**0.12**	**0**	**0**	**0.33**	**0**	**0**	**0**	**0**	**1.00**
Large Corvids	**0.12**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.08**	**0**	**0**	**0**
Large Birds Overall	**0.25**	**0.38**	**0.42**	**0.38**	**888.83**	**0.50**	**5.67**	**0.29**	**0.33**	**1.00**	**3.25**	**1.71**

[a.] 2,625 feet (800-meter) radius survey plot for large birds

Appendix D (*Continued*). Mean use (number of birds/60-minute survey) by point[a] for all major large bird types and diurnal raptor subtypes observed during large bird use surveys conducted within the Emmons-Logan Wind Energy Center and 230 kV Transmission Line in Emmons and Logan counties, North Dakota, from April 4, 2017 – March 27, 2018.

	Survey Point										
Bird Type	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
Waterbirds	**0**	**0**	**18.75**	**0.12**	**22.50**	**0**	**0**	**0**	**1.67**	**5.42**	**0**
Waterfowl	**20.83**	**0.36**	**0**	**0.50**	**147.25**	**0**	**0**	**100**	**8.58**	**38.17**	**3.75**
Shorebirds	**0.17**	**0.09**	**0**	**0**	**0**	**0**	**0.17**	**0.08**	**0.08**	**0**	**0.17**
Gulls/Terns	**0**	**0**	**0**	**0**	**2.08**	**0**	**0**	**0**	**0**	**0**	**0**
Diurnal Raptors	**0.17**	**0.18**	**0.12**	**0.50**	**0**	**0.22**	**0.17**	**0.33**	**0.25**	**0.33**	**0.17**
Accipiters	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Buteos	*0*	*0.18*	*0.12*	*0.38*	*0*	*0*	*0.08*	*0.08*	*0.17*	*0.25*	*0.17*
Northern Harrier	*0.17*	*0*	*0*	*0.12*	*0*	*0.22*	*0*	*0.25*	*0.08*	*0*	*0*
Eagles	*0*	*0*	*0*	*0*	*0*	*0*	*0.08*	*0*	*0*	*0*	*0*
Falcons	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Other Raptors	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0.08*	*0*
Vultures	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Upland Game Birds	**0**	**0.09**	**0.25**	**0**	**0**	**0**	**0.08**	**0**	**0**	**0**	**0**
Doves/Pigeons	**0**	**0**	**0**	**0.38**	**0**	**0**	**0**	**0**	**0.08**	**0.17**	**0**
Large Corvids	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Large Birds Overall	**21.17**	**0.73**	**19.12**	**1.50**	**171.83**	**0.22**	**0.42**	**100.42**	**10.67**	**44.08**	**4.08**

[a.] 2,625 feet (800-meter) radius survey plot for large birds

Appendix E. Wind Energy Facilities in Midwestern North America with Comparable Raptor Use and Fatality Data.

Appendix E. Wind energy facilities in Midwestern North America with comparable use and fatality data for raptors.

Project Name	Raptor Use Estimate[a]	Raptor Fatality Estimate[b]	Total Number of Turbines	Total Megawatts	Use Reference	Fatality Reference
Emmons-Logan 2017-2018, ND	**0.18**	**xx**	**xx**	**xx**	**This Study**	**xx**
Buffalo Ridge, MN (Phase I; 1999)	NA	0.47	73	25	NA	Johnson et al. 2000a
Moraine II, MN (2009)	NA	0.37	33	49.5	NA	Derby et al. 2010g
Winnebago, IA (2009-2010)	NA	0.27	10	20	NA	Derby et al. 2010h
Buffalo Ridge I, SD (2009-2010)	NA	0.20	24	50.4	NA	Derby et al. 2010e
Cedar Ridge, WI (2009)	NA	0.18	41	67.6	NA	BHE Environmental 2010
PrairieWinds SD1, SD (2013-2014)	NA	0.17	108	162	NA	Derby et al. 2014
Top of Iowa, IA (2004)	NA	0.17	89	80	NA	Jain 2005
Cedar Ridge, WI (2010)	NA	0.13	41	68	NA	BHE Environmental 2011
Ripley, Ont (2008)	NA	0.10	38	76	NA	Jacques Whitford 2009
Wessington Springs, SD (2010)	0.23	0.07	34	51	Derby et al. 2008	Derby et al. 2011a
NPPD Ainsworth, NE (2006)	NA	0.06	36	20.5	NA	Derby et al. 2007
Rugby, ND (2010-2011)	NA	0.06	71	149	NA	Derby et al. 2011c
Wessington Springs, SD (2009)	0.23	0.06	34	51	Derby et al. 2008	Derby et al. 2010d
PrairieWinds ND1 (Minot), ND (2010)	NA	0.05	80	116	NA	Derby et al. 2011d
PrairieWinds ND1 (Minot), ND (2011)	NA	0.05	80	116	NA	Derby et al. 2012d
PrairieWinds SD1, SD (2012-2013)	NA	0.03	108	162	NA	Derby et al. 2013
Barton I & II, IA (2010-2011)	NA	0.00	80	160	NA	Derby et al. 2011b
Big Blue, MN (2013)	NA	0.00	18	36	NA	Fagen Engineering 2014
Big Blue, MN (2014)	NA	0.00	18	36	NA	Fagen Engineering 2015
Blue Sky Green Field, WI (2008; 2009)	NA	0.00	88	145	NA	Gruver et al. 2009
Buffalo Ridge II, SD (2011-2012)	NA	0.00	105	210	NA	Derby et al. 2012a
Buffalo Ridge, MN (Phase I; 1996)	NA	0.00	73	25	NA	Johnson et al. 2000a
Buffalo Ridge, MN (Phase I; 1997)	NA	0.00	73	25	NA	Johnson et al. 2000a
Buffalo Ridge, MN (Phase I; 1998)	NA	0.00	73	25	NA	Johnson et al. 2000a
Buffalo Ridge, MN (Phase II; 1998)	NA	0.00	143	107	NA	Johnson et al. 2000a
Buffalo Ridge, MN (Phase II; 1999)	NA	0.00	143	107	NA	Johnson et al. 2000a
Buffalo Ridge, MN (Phase III; 1999)	NA	0.00	138	104	NA	Johnson et al. 2000a
Elm Creek II, MN (2011-2012)	NA	0.00	62	149	NA	Derby et al. 2012b
Elm Creek, MN (2009-2010)	NA	0.00	67	100	NA	Derby et al. 2010f
Fowler I, IN (2009)	NA	0.00	162	301	NA	Johnson et al. 2010
Grand Ridge I, IL (2009-2010)	0.20	0.00	66	99	Derby et al. 2009	Derby et al. 2010a
Kewaunee County, WI (1999-2001)	NA	0.00	31	20.5	NA	Howe et al. 2002
Pioneer Prairie II, IA (2011-2012)	NA	0.00	62	102	NA	Chodachek et al. 2012
PrairieWinds SD1, SD (2011-2012)	NA	0.00	108	162	NA	Derby et al. 2012c

Appendix E. Wind energy facilities in Midwestern North America with comparable use and fatality data for raptors.

Project Name	Raptor Use Estimate[a]	Raptor Fatality Estimate[b]	Total Number of Turbines	Total Megawatts	Use Reference	Fatality Reference
Rail Splitter, IL (2012-2013)	NA	0.00	67	101	NA	Good et al. 2013
Top of Iowa, IA (2003)	NA	0.00	89	80	NA	Jain 2005

[a.] Number of raptors/plot/20-minute survey

[b.] Number of fatalities/Megawatt/year