Firelands Wind, LLC
Case No. 18-1607-EL-BGN

Application Part 8 of 17

<u>Part 8 includes</u>:

- **Exhibit S** **Raptor Migration/Use Surveys**
- **Exhibit T** **Passerine Migration Surveys**
- **Exhibit U** **Eagle Use Surveys**
- **Exhibit V** **Breeding Bird Surveys**
- **Exhibit W** **Owl Surveys**
- **Exhibit X** **Acoustic Bat Surveys**

Date Filed: January 31, 2019

Christine M.T. Pirik (0029759)
(Counsel of Record)
Terrence O'Donnell (0074213)
William V. Vorys (0093479)
Dickinson Wright PLLC
150 East Gay Street, Suite 2400
Columbus, Ohio 43215
Phone: (614) 591-5461
Email: cpirik@dickinsonwright.com
todonnell@dickinsonwright.com
wvorys@dickinsonwright.com

Attorneys for Firelands Wind, LLC

Exhibit S
Raptor Migration/Use Surveys

1. **Large Bird and Eagle Use Surveys for the Emerson Creek Wind Project Huron and Erie Counties, Ohio dated May 8, 2018**
2. **Large Bird and Eagle Use Surveys for the Emerson Creek Wind Project Huron County, Ohio dated September 10, 2018**
3. **Wildlife Baseline Studies for the Emerson Creek Wind Resource Area Seneca and Huron Counties, Ohio dated February 6, 2013**
4. **Avian Survey Report dated July 20, 2012**

Christine M.T. Pirik (0029759)
(Counsel of Record)
Terrence O'Donnell (0074213)
William V. Vorys (0093479)
Dickinson Wright PLLC
150 East Gay Street, Suite 2400
Columbus, Ohio 43215
Phone: (614) 591-5461
Email: cpirik@dickinsonwright.com
todonnell@dickinsonwright.com
wvorys@dickinsonwright.com

Attorneys for Firelands Wind, LLC

Exhibit S
Raptor Migration/Use Surveys

1. Large Bird and Eagle Use Surveys for the Emerson Creek Wind Project Huron and Erie Counties, Ohio dated May 8, 2018

Christine M.T. Pirik (0029759)
(Counsel of Record)
Terrence O'Donnell (0074213)
William V. Vorys (0093479)
Dickinson Wright PLLC
150 East Gay Street, Suite 2400
Columbus, Ohio 43215
Phone: (614) 591-5461
Email: cpirik@dickinsonwright.com
todonnell@dickinsonwright.com
wvorys@dickinsonwright.com

Attorneys for Firelands Wind, LLC

Large Bird and Eagle Use Surveys for the Emerson Creek Wind Project Huron and Erie Counties, Ohio

September 30, 2016 – December 18, 2017

Final Report

Prepared by:

Goniela Iskali and Chad LeBeau

Western EcoSystems Technology, Inc.

408 West Sixth Street
Bloomington, Indiana 47404

May 8, 2018

EXECUTIVE SUMMARY

Western EcoSystems Technology, Inc. completed year-round large bird and eagle use surveys for the proposed Emerson Creek Wind Project (Project) in Huron and Erie counties, Ohio from September 2016 through December 2018. The objectives of the surveys were to: 1) provide estimates of large bird use throughout the year; 2) evaluate species composition and seasonal and spatial use by birds, including special status species; 3) assess raptor migration during the spring and fall seasons, and 4) assess risk to eagles and sensitive species. The surveys were completed in coordination with the US Fish and Wildlife Service (USFWS) and Ohio Department of Natural Resources (ODNR) and in accordance with the tiered process outlined in the USFWS Final *Land-Based Wind Energy Guidelines,* USFWS *Eagle Conservation Plan Guidance* (ECPG), and ODNR *On-Shore Bird and Bat Pre- and Post-Construction Monitoring Protocol for Commercial Wind Energy Facilities in Ohio*.

Surveys were completed monthly from September 30, 2016, through December 18, 2017, at 23 points established throughout the Project area. Surveys were 60-minutes (min) in duration and consisted of large bird and eagle use surveys within an 800-meter (m; 2,625-foot) radius of the surveyor. All large birds were recorded during the first 20 min of each 60-min count, while only eagles and federal- and/or state-listed species were recorded for the remaining 40 min.

A total of 19 species (2,924 observations) were recorded during the 20-min large bird surveys, of which six species were diurnal raptors. Seasonal diurnal raptor use was as follows: spring (0.35 bird/800-m plot/20-min survey), winter (0.34), summer (0.33), and fall (0.09). Diurnal raptor use was low overall compared to other projects with publicly-available data, where diurnal raptor use ranged from 0.06 to 2.34 raptors/800-m plot/20-min survey. Raptor migration during the spring and fall does not appear to be concentrated within the Project as diurnal raptor use was similar among spring, summer and winter and lowest during the fall.

A total of 52 bald eagle observations in 46 groups were observed during the 60-min surveys. A total of 68 eagle risk minutes, as defined by the ECPG, were recorded, of which 39 minutes (66%) were recorded at two points located near an active bald eagle nest within the Project. Bald eagles were recorded using the Project during all seasons, but were detected more frequently from March to July, near an eagle nest located in the northern portion of the Project. The known active bald eagle nest within the Project may warrant management consideration, such as avoiding siting turbines in close proximity to the nest to reduce potential collision risk in this higher use area.

No federally listed threatened or endangered species were observed during the surveys. One state-listed endangered species (northern harrier) was recorded during the surveys (n=22). Northern harrier use of the Project was low during the summer breeding period which is likely the result of limited breeding habitat within the Project due to the amount of cultivated croplands present. The majority of the northern harrier observations were recorded in the winter (68%), and were below the rotor-swept height. Overall the Project site presents species composition

and seasonal and spatial use patterns for birds typical for the region and is not likely to cause significant impacts to large bird populations, including diurnal raptors or special-status species.

STUDY PARTICIPANTS

Western EcoSystems Technology, Inc.

Goniela Iskali	Project Manager
Chad LeBeau	Senior Reviewer
John Lombardi	Statistician
Mandy Kauffman	Statistician
Carissa Goodman	Data Analyst
Jeff Fruhwirth	GIS Technician
Wendy Bruso	Technical Editing Manager
Katie Michaels	Technical Editing Coordinator
Dave Klein	Technical Editor
Dan Kramer	Field Technician

REPORT REFERENCE

Iskali, G, and C. LeBeau. 2018. Large Bird and Eagle Use Surveys for the Emerson Creek Wind Project, Huron and Erie Counties, Ohio. September 30, 2016 – December 18, 2017. Prepared by Western EcoSystems Technology, Inc. (WEST), Bloomington, Indiana. May 8, 2018.

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INTRODUCTION

This report presents the results of the 2016 – 2017 large bird and eagle use surveys completed by Western EcoSystems Technology, Inc. (WEST) for the Emerson Creek Wind Project (Project) located in Huron and Erie counties, Ohio. Survey protocols were developed in coordination with the US Fish and Wildlife Service (USFWS) and Ohio Department of Natural Resources (ODNR), and were consistent with recommendations within the *Final Land-Based Wind Energy Guidelines* (WEG; USFWS 2012), and the USFWS *Eagle Conservation Plan Guidance* (ECPG; USFWS 2013 and 2016b). The objectives of the surveys were to: 1) provide estimates of large bird use throughout the year; 2) evaluate species composition and seasonal and spatial use by birds, including special status species; 3) assess raptor migration during the spring and fall seasons; and 4) assess risk to eagles and sensitive species.

PROJECT AREA

The proposed 159.6-square kilometer (km^2; 39,442-acre [ac]) Project is located 1.9 km (less than 1.2 mile [mi]) east of Bellevue, Ohio. According to the US Geological Survey (USGS) National Land Cover Dataset (NLCD), the Project area is dominated by croplands (88.1%; Table 1, Figure 1; USGS NLCD 2011, Homer et al. 2015), including corn (*Zea mays*) and soybeans (*Glycine max*). Developed areas (6.5%) and deciduous forests (4.3%) are the next most common land cover types within the Project area (Table 1). All other land cover types compose less than 1.0% of the Project, individually (Table 1, Figure 1).

Table 1. Land cover types and composition at the Emerson Creek Wind Project.

Habitat	Acres	% Composition
Cultivated Crops	34,722	88.0
Developed	2,572	6.5
Deciduous Forest	1,680	4.3
Hay/Pasture	286	0.7
Open Water	170	0.4
Barren Land	3	<0.1
Shrub/Scrub	3	<0.1
Evergreen Forest	2	<0.1
Woody Wetlands	2	<0.1
Emergent Herbaceous Wetlands	1	<0.1
Total	**39,442**	**100**

Data from USGS NLCD 2011, Homer et al. 2015

Values may not add up due to rounding.

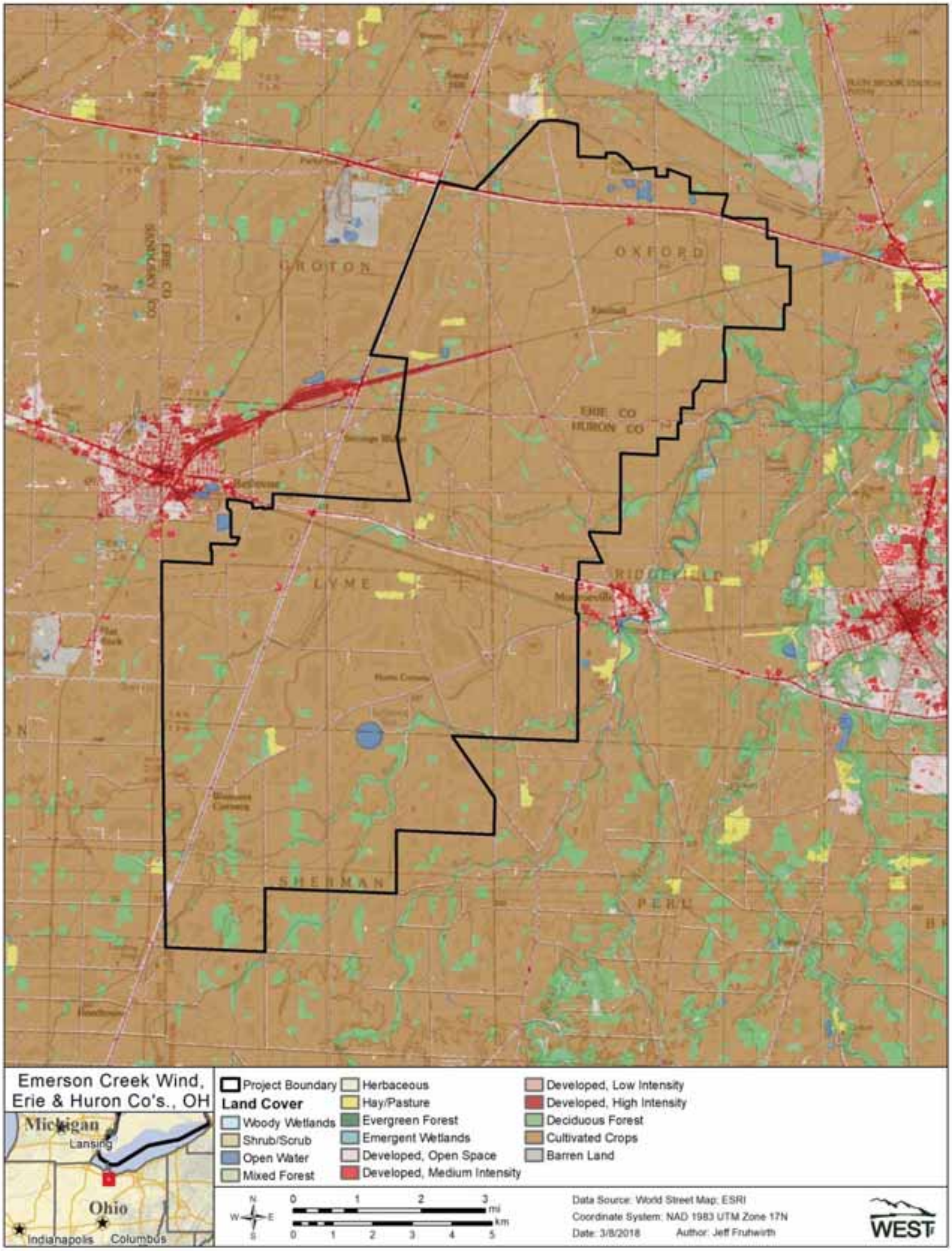

Figure 1. Land cover within the Emerson Creek Wind Project (USGS NLCD 2011, Homer et al. 2015) in Huron and Erie counties, Ohio.

METHODS

Large bird and eagle use surveys were completed monthly for a full year at 23 points throughout the Project from September 30, 2016 to December 18, 2017, in accordance with methods described by Reynolds et al. (1980). Most points were surveyed from September 2016 to September 2017, but one point (Point 40) was added in January 2017 due to a Project expansion and surveyed for a full year until December 18, 2017 (Figure 2). Each survey point was located to maximize viewshed for the observer and to enable evaluation of representative habitats within and near the Project. The 800-meter (m; 2,625 feet [ft]) radius plots used in this evaluation are representative of potential development areas and encompassed approximately 30% of the Project as currently proposed.

Each survey point was surveyed for a total of 60 minutes (min). The large bird use surveys were completed during the first 20 mins, during which all large birds within 800 m were recorded. The eagle use survey was completed for the entire 60 min period during which all eagles within 800 m of the observer were recorded.

For purposes of this study, large birds were defined as waterbirds, waterfowl, shorebirds, diurnal raptors (kites, accipiters, buteos, eagles, falcons, northern harrier, and osprey), vultures, upland game birds, doves and pigeons, large corvids, and goatsuckers. The 20-min portion of the survey allowed for standardization and comparison of data with other wind energy facilities throughout the region, while the 60-min eagle counts allowed for more robust evaluation of bald (*Haliaeetus leucocephalus*) and golden eagle (*Aquila chrysaetos*) use of the site in accordance with the USFWS ECPG (USFWS 2013). In addition, these surveys were used to assess raptor migration during the spring (March 15 – May 1) and fall (September 1 – October 31) in accordance with ODNR Protocols and as agreed upon with ODNR.

Observations of sensitive species (defined as species afforded protection under the Endangered Species Act [1973], Bald and Golden Eagle Protection Act [1940], listed as threatened or endangered by the state of Ohio [ODNR; 2016], or Birds of Special Conservation Concern [USFWS 2018]) were recorded throughout the 60-min surveys. Observations of sensitive species beyond the 800-m radius plot and in-transit were recorded as incidental observations to document occurrence on site, but were excluded from statistical analyses of mean use.

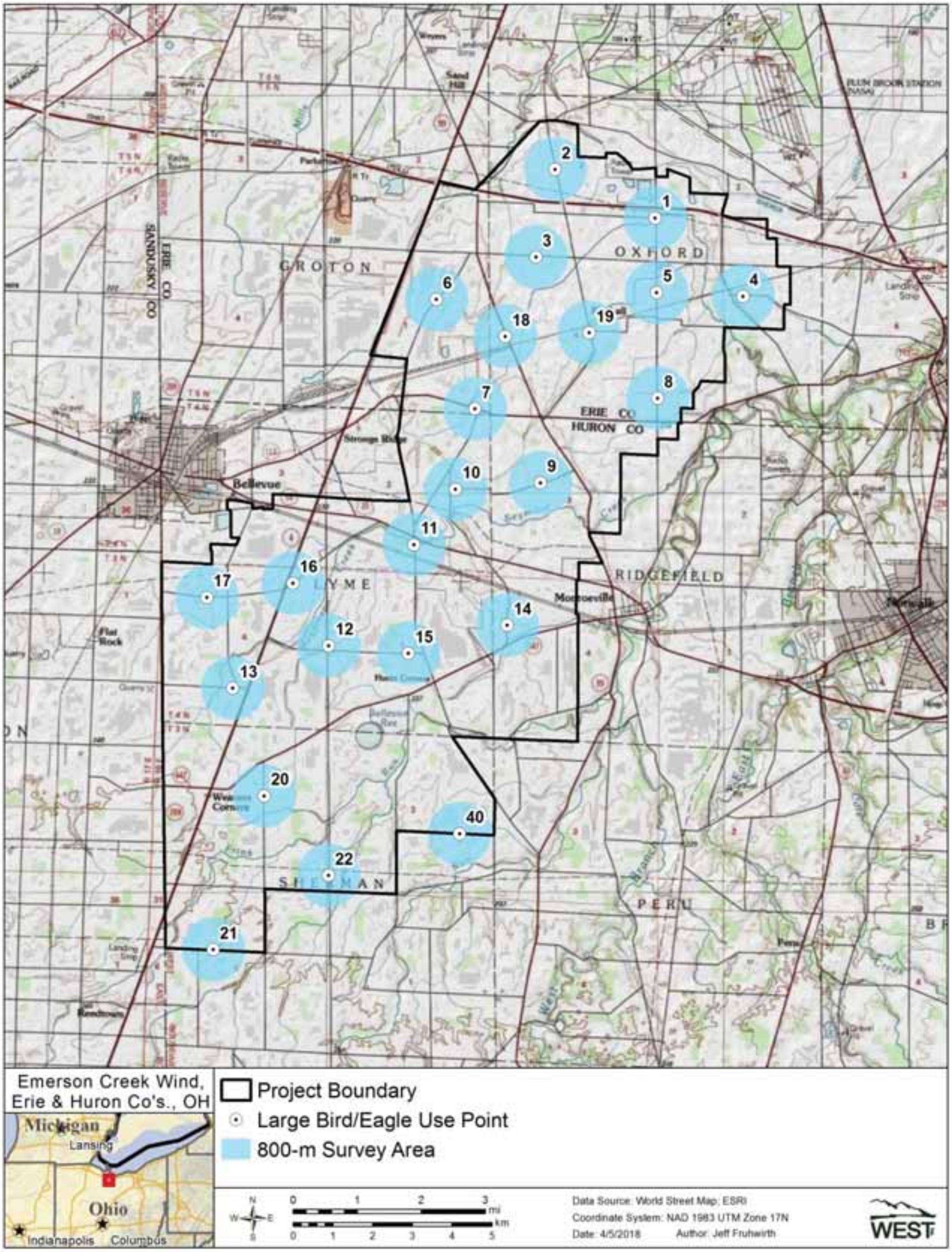

Figure 2. Observation point locations used during large bird/eagle use surveys at the Emerson Creek Wind Project based from September 30, 2016, through December 18, 2017.

At each survey point, the date, start and end time of the survey period, and weather information (e.g., temperature, wind speed and direction, and cloud cover) were recorded. Species or best possible identification, number of individuals, sex and age class (if possible), distance from plot center when first observed, closest distance, flight height or altitude above ground, activity (behavior), and habitat(s) were recorded for each observation. Approximate flight height and distance from plot center at first observation were recorded to the nearest 1-m (3-ft) interval. Eagle risk minutes (i.e., minutes of eagles flying within 800 m and below 200 m [656 ft]) were documented in accordance with the ECPG. Locations of sensitive species were recorded on field maps by unique observation number. In addition, flight paths of eagles and sensitive species were recorded on aerial maps and labeled by the unique observation number corresponding to the mapped individual.

Statistical Analysis

Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) measures were implemented at all stages of the surveys, including in the field, during data entry and analysis, and report writing. Observers were responsible for inspecting data forms for completeness, accuracy, and legibility following each field survey. Potentially erroneous data were identified using a series of database queries. Irregular codes or data suspected as 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® SQL 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 and electronic data files were retained for reference.

Fixed-Point Count Avian Use Surveys

For analysis purposes, a visit was defined as the required length of time, in days, to survey all of the plots once within the Project. Seasons were defined as spring (March 1 to May 31), summer (June 1 to August 30), fall (September 1 to November 30) and winter (December 1 to February 28).

Bird Diversity and Species Richness

Bird diversity for all large bird use surveys was illustrated by the total number of species identified. Species lists and counts, with the number of observations and the number of groups, were generated by season and included all observations of birds detected within 800 m. In some cases, the tally of observations may represent repeated sightings of the same individual. Species richness was calculated as the mean number of species observed per plot per survey, and was compared between seasons.

Mean Use, Seasonal Variations, and Frequency of Occurrence

Large birds detected within the 800-m radius plot were used to calculate mean use and frequency of occurrence of large birds. The metric used to measure mean large bird use was number of birds per plot per 20-min survey. Seasonal large bird mean use was calculated by first averaging the total number of birds seen within each plot during a visit, then averaging across 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 use of raptors per 20-min survey was used to assess seasonal raptor use and was additionally compared to use by other wind energy projects with publically available data in the Midwest.

Frequency of occurrence provides a relative measure of species exposure to the proposed facility and was calculated as the percent of surveys in which a particular bird type or species was observed.

Bird Flight Height and Behavior

The flight height recorded during the initial observation was used to calculate the percentage of birds flying within the rotor swept heights (RSH; estimated to be between 25 and 200 m [82 to 656 ft] above ground level) and mean flight height during the fixed-point count large bird use surveys. The percentage of birds flying within the RSH at any time was calculated using the lowest and highest flight heights recorded. Auditory only observations were excluded from flight height calculations.

Spatial Use and Mapping

Spatial use in the Project was evaluated by comparing mean use by point location and qualitative review of flight paths. Flight paths of all eagle and sensitive species were digitized and mapped in order to examine spatial patterns of use within the Project.

RESULTS

A total of 268 large bird and eagle use surveys were completed between September 30, 2016 and December 18, 2017, resulting in 89 hours of 20-min large bird use surveys and 268 hours of ECPG-level eagle use surveys.[1] Details on the number of observations and groups recorded by species within the survey plots are presented in Appendix A, and details on mean use, percent of use, and frequency of occurrence are presented in Appendices B and C.

Large Bird Use

A total of 19 species (2,924 individual observations) were recorded during the large bird surveys (Appendix A). Two species of waterfowl composed 83.2% of all large bird observations: Canada goose (*Branta canadensis*; 75.8%), and tundra swan (*Cygnus columbianus*; 7.9%). Turkey

[1] The fall period assessed includes mainly fall 2016 data and only one point was surveyed in the fall 2017, and therefore the use documented and inference to risk for fall only applies to fall 2016.

vulture (*Cathartes aura*; 2.7%), killdeer (*Charadrius vociferus;* 2.6%), rock pigeon (*Columba livia*; 2.6%), and mourning dove (*Zenaida macroura*; 2.4%) were the next most commonly observed species. All other species accounted for approximately 2.0% or fewer of the observations, individually (Appendix A).

Overall large bird use was highest during the winter (29.17 birds/800-m plot/20-min survey), followed by summer (1.90), fall (1.78), and spring (1.59; Table 2). Higher use in the winter can be largely attributed to higher use by Canada geese (76% of all large bird observations). The number of species of large birds recorded was higher in the fall (n=18) but fairly consistent among the other three seasons: spring (n=16), summer (n=12), and winter (n=13). However, large bird species richness per plot per survey was slightly higher in the summer (1.13 species/800-m plot/20-min survey) compared to spring (0.96), winter (0.78) and fall (0.57). Overall large bird species richness was 0.86 bird species/800-m plot/20-min survey.

No federally listed threatened or endangered large bird species were observed during the 20-min surveys or incidentally. One state-listed endangered species (ODNR 2016), northern harrier (*Circus cyaneus*) was documented (10 observations during surveys). Northern harrier use was relatively low but highest in the winter (0.07 birds/800-m plot/20-min survey), with very low use in spring (0.04 and summer (0.01) and no use in fall. Twenty-eight bald eagles in 26 groups were observed during the 20-min surveys resulting in the following mean use by season: spring (0.14 birds/800-m plot/20-min survey), summer (0.12), winter (0.01) and fall (<0.01). Eagle use is discussed in more detail below and summarized with respect to the full 60-min surveys.

Diurnal Raptors

A total of six diurnal raptor species (96 observations) were documented over the course of the 20-min large bird surveys. Diurnal raptor use was similar during the spring (0.35 bird/800-m plot/20-min survey), winter (0.34), and summer (0.33) and lowest during the fall (0.09; Table 2). Diurnal raptor use was primarily attributable to use of the area by red-tailed hawk (*Buteo jamaicensis*), which had the highest overall use of any diurnal raptor (Appendix B). Diurnal raptors accounted for 29.0% of large bird use in summer, 25.3% in winter, 24.6% in the spring and, and 8.5% in fall. Diurnal raptor use at each observation point ranged from 0 birds/800-m plot/20-min survey to 0.58 birds/800-m plot/20-min survey, with the higher use being recorded at points 2, 10 and 11 (Figure 2; Appendix C).

Table 2. Mean large bird use (number of birds/800-m plot/20-min survey), percent of total use (%), and frequency of occurrence (%) for each bird type and species by season during large bird and eagle use surveys at the Emerson Creek Wind Project from September 30, 2016 to December 18, 2017.

	Mean Use				% of Use				% Frequency			
Type/Species	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**
Waterbirds	0.06	0.13	<0.01	0	3.6	6.9	0.5	0	5.8	8.7	0.9	0
Waterfowl	0.1	0	0	26.72	6.4	0	0	91.6	4.3	0	0	6.6
Shorebirds	0.42	0.26	0.36	0.02	26.4	13.7	20.2	<0.1	18.8	20.3	7	1.1
Gulls/Terns	0.03	0	0	0.01	1.8	0	0	<0.1	2.9	0	0	1.1
Diurnal Raptors	0.35	0.33	0.09	0.34	21.8	17.6	5.3	1.2	24.6	29	8.5	25.3
Owls	0.01	0	0	0	0.9	0	0	0	1.4	0	0	0
Vultures	0.2	0.75	0.12	0	12.7	39.7	6.8	0	11.6	31.9	9.8	0
Doves/Pigeons	0.28	0.36	0.36	0.71	17.3	19.1	20.2	2.4	14.5	20.3	5.3	5.5
Large Corvids	0.14	0.06	0.84	1.37	9.1	3.1	47	4.7	10.1	2.9	25.5	33.9
Overall	**1.59**	**1.9**	**1.78**	**29.17**	**100**	**100**	**100**	**100**				

Values may not add up due to rounding.

Large Bird and Diurnal Raptor Flight Height and Behavior

During the large bird surveys, 588 large bird observations in 205 groups were recorded as flying (Table 3). Overall, 71.6% of large bird observations were within the RSH, 27.6% were below the RSH, and 0.9% were above the RSH. Vultures had the highest percentage of observations recorded within the RSH (94.6%) followed by waterfowl (88.1%). Diurnal raptors were estimated to be within the RSH 59.7% or more of the time during 800-m plot/20-min surveys (Table 3).

Table 3. Flight height characteristics by large bird type and raptor subtype within 800-meters and in the first 20-minutes of the large bird and eagle use surveys at the Emerson Creek Wind Project from September 30, 2016 to December 18, 2017.

Bird Type	# Groups Flying	# Ind Flying	Estimated Mean Flight Height (m)	% Obs Flying	% Estimated within Flight Height Categories		
					0 - 25 m	25 - 200 m[a]	> 200 m
Waterbirds	11	14	52	100	50	50	0
Waterfowl	9	219	58	8.9	11.9	88.1	0
Shorebirds	28	42	25	55.3	64.3	35.7	0
Gulls/Terns	3	3	70	100	33.3	66.7	0
Diurnal Raptors	**58**	**67**	**86**	**76.1**	**34.3**	**59.7**	**6**
Accipiters	4	4	93	80	50	50	0
Buteos	23	31	69	73.8	29	67.7	3.2
Northern Harrier	9	9	2	90	100	0	0
Eagles	18	19	159	95	0	84.2	15.8
Falcons	4	4	41	36.4	75	25	0
Owls	1	1	4	100	100	0	0
Vultures	45	74	82	97.4	4.1	94.6	1.4
Doves/Pigeons	34	136	20	91.9	41.2	58.8	0
Large Corvids	16	32	35	60.4	56.2	43.8	0
Large Birds Overall	**205**	**588**	**58**	**20.2**	**27.6**	**71.6**	**0.9**

[a] The likely "rotor-swept height" for potential collision with a turbine blade above ground level

Ind = individuals; m = meters; Obs = observed

Values may not add up due to rounding.

Raptor Migration

The spring and fall seasons defined in this analysis are comparable to those outlined in the ODNR Protocol for raptor migration surveys (e.g., spring [March 15 to May 1] and fall [September 1 to October 31]). Raptor migration during the spring and fall does not appear to be concentrated within the Project as diurnal raptor use was similar among three seasons and lowest during the fall (Table 2). Three raptors: red-tailed hawk, bald eagle and American kestrel (*Falco sparverius*) were observed during all the seasons at the Project and are considered common raptor species of the Midwest (Pardieck et al. 2017). Northern harriers were observed during most seasons, with the exception of fall, but were most commonly observed in the winter. Accipiters were rarely observed at the Project; Cooper's hawk (*Accipiter cooperii*) was only observed in the summer and winter in low numbers (two individuals for each season), and sharp-shinned hawk (*Accipiter striatus*) had only one observation recorded during the winter (Appendix A). Overall, concentrations of raptors were not observed during surveys with respect to spatial or temporal patterns.

Eagles

A total of 52 bald eagle observations in 46 groups were observed during 268 hours of all 60-min surveys across the entire year within 800 m (2,625 ft) of survey locations (Tables 4a and 4b). No golden eagles were observed during the surveys. Bald eagles were observed at 17 of the 23 survey points, however, 49% of the use occurred at three points: Eleven of the 52 observations were recorded at Point 2, which is located 0.3 mi (0.5 km) from a known nest; seven observations were recorded at Point 40, which is located 0.9 mi (1.5 km) from a second known nest outside of the Project; and seven observations were recorded at Point 4, which is not near any known eagle nests. The remainder of the observations were scattered throughout the Project at relatively low levels. Overall mean use was 0.19 eagles/800-m survey/60-min survey across the entire study period and the total number of risk minutes documented was 68.

Seasonal mean use varied from 0.04 in winter to 0.23 in spring. Approximately 65.8% of all eagle observations were within the RSH. Eagle flight paths are presented in Figure 4. The highest numbers of eagle risk minutes were recorded at points 1 (20 mins from three eagles) and 2 (19 mins from seven eagles), which are near the northern eagle nest, and represent 57% of the eagle risk minutes recorded during surveys. If the data from Point 2 are excluded (i.e., if the Project is revised to avoid this nest), the total number of risk minutes drops to 48 (Table 4b).

Table 4a. Number of bald eagle observations and estimated risk minutes within 800 m of the observer and below 200 m flight height during eagle use surveys at Emerson Creek Wind Project from September 30, 2016 to December 18, 2017.

Season	Bald Eagle Observations	Estimated Bald Eagle Risk Minutes	Survey Effort (hours)	Bald Eagle Observations/Hour
Spring	22	32	69	0.32
Summer	10	21	69	0.14
Fall	11	8	61	0.18
Winter	9	7	69	0.13
Total	**52**	**68**	**268**	**0.19**

Table 4b. Number of bald eagle observations and estimated risk minutes within 800 m of the observer and below 200 m flight height during eagle use surveys at Emerson Creek Wind Project from September 30, 2016 to December 18, 2017.

Survey Location	Bald Eagle Observations within 800 m	Estimated Bald Eagle Risk Minutes	Survey Effort (hours)	Bald Eagle Observations within 800 m /Hour	Bald Eagle Risk Minutes/Hour
1	4	19	12	0.33	1.58
2	11	20	12	0.92	1.67
3	0	0	12	0.00	0.00
4	7	6	12	0.58	0.50
5	2	1	12	0.17	0.08
6	1	1	12	0.08	0.08
7	4	6	12	0.33	0.50
8	1	0	12	0.08	0.00
9	0	0	12	0.00	0.00
10	0	0	12	0.00	0.00

11	2	0	12	0.17	0.00
12	1	2	12	0.08	0.17
13	0	0	11	0.00	0.00
14	1	0	12	0.08	0.00
15	1	0	11	0.09	0.00
16	0	0	11	0.00	0.00
17	0	0	11	0.00	0.00
18	3	3	11	0.27	0.27
19	1	1	11	0.09	0.09
20	4	5	11	0.36	0.45
21	1	4	12	0.08	0.33
22	1	0	11	0.09	0.00
40	7	0	12	0.58	0.00
Total	**52**	**68**	**268**	**0.19**	**1.58**

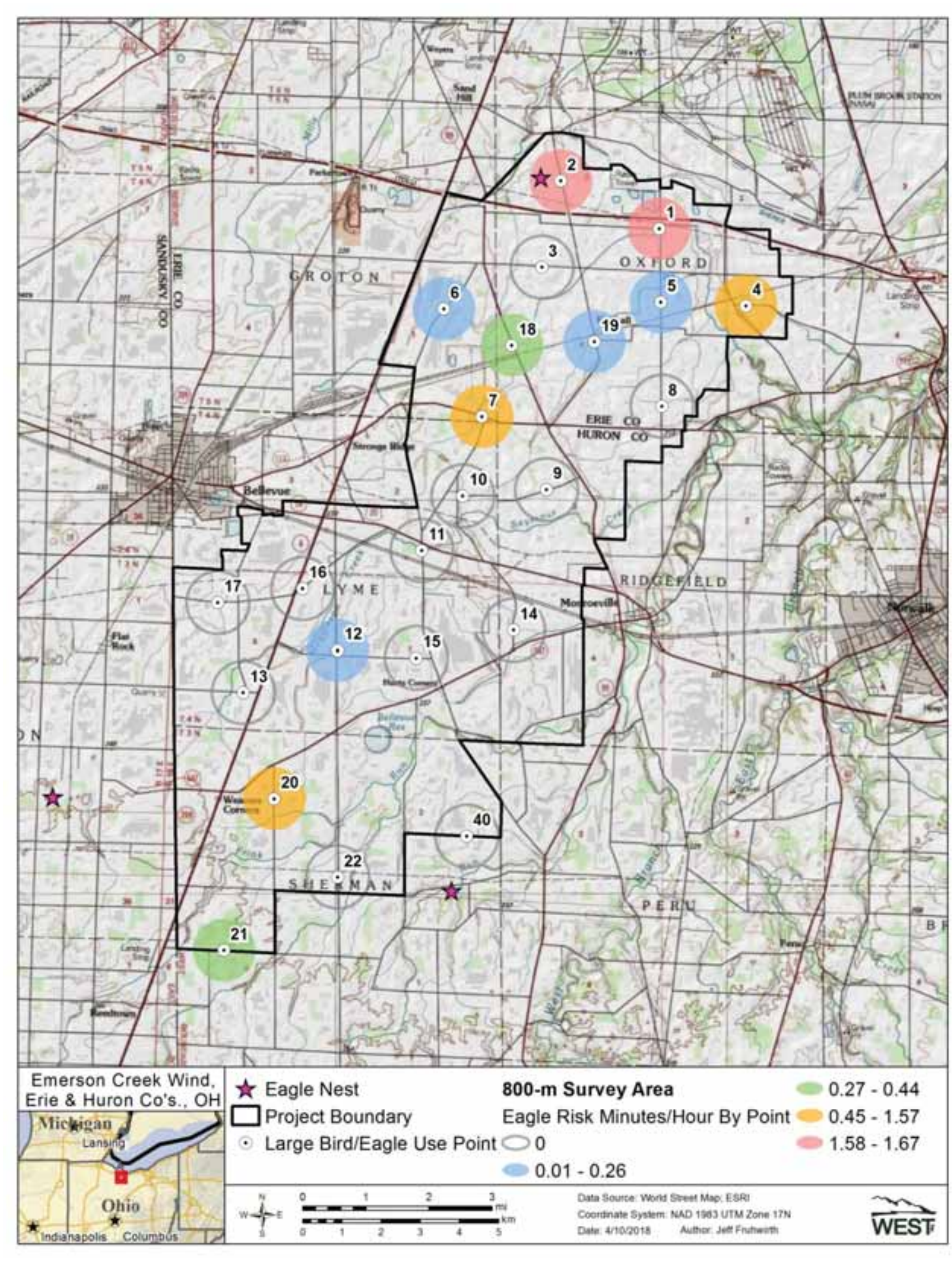

Figure 3. Bald eagle risk minutes within 800 meters and flying below 200 m per hour by observation point during eagle use surveys conducted at Emerson Creek Wind Project from September 30, 2016 to December 18, 2017.

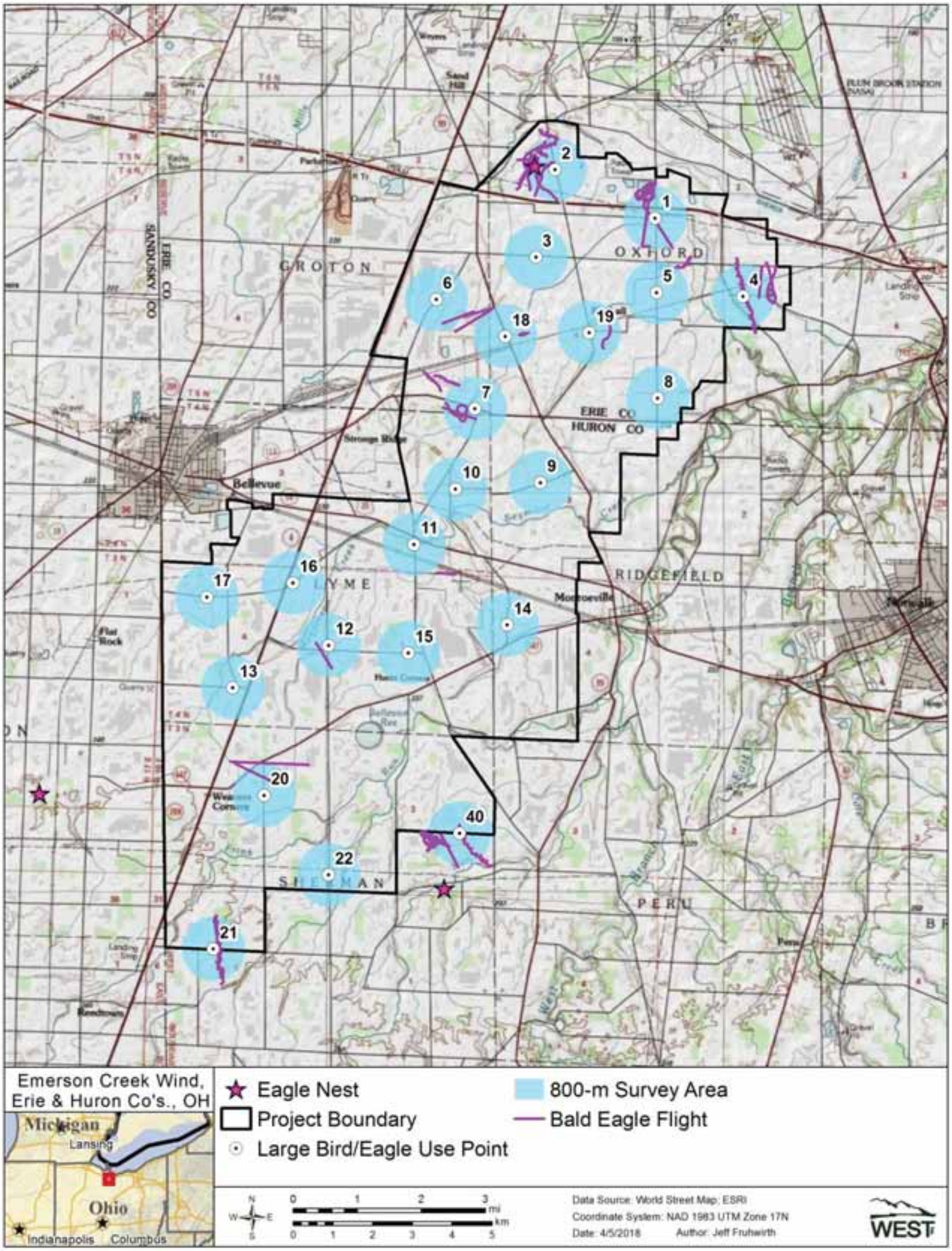

Figure 4. Estimated flight paths of bald eagles recorded during large bird and eagle use surveys at the Emerson Creek Wind Project from September 30, 2016 to December 18, 2017.

Sensitive Species

No federally-listed species or Birds of Conservation Concern were recorded and only one state-listed species was recorded during the 60-min surveys: the state-endangered northern harrier (*Circus cyaneus*; n=22).

DISCUSSION

Large Birds

Large bird species most often observed in the large bird surveys included Canada goose, tundra swan, killdeer, rock pigeon, turkey vulture, and mourning dove. These large bird species observed are common, geographically abundant and species whose populations are likely to be unaffected by any potential habitat fragmentation or collision related to the Project. Thus impacts to large bird populations during all seasons are unlikely to be significant.

Diurnal Raptors

Estimates of potential mean raptor use are often made to assess potential impacts by comparing them with other wind-energy project's fatality estimates. WEST compared the mean raptor use of the Project with 46 other publicly available wind energy facilities that implemented similar protocols and had data recorded for three or four seasons. The annual mean raptor use at these 46 wind energy facilities ranged from 0.06 to 2.34 raptors/800-m plot/20-min survey (Appendix D). Within the Midwest, diurnal raptor fatality rates have ranged from zero to 0.59 raptors/megawatt (MW)/year, with a mean of 0.07 raptors/MW/year (Appendix E).

A relative ranking of annual mean raptor use was developed based on the results from these 46 wind energy facilities as low (0 – 0.5 raptors/800-m plot/20-min survey), low to moderate (0.5 – 1.0 raptors/800-m plot/20-min survey), moderate (1.0 – 2.0 raptors/800-m plot/20-min survey), high (2.0 – 3.0 raptors/800-m plot/20-min survey), and very high (more than 3.0 raptors/800-m plot/20-min survey). Under this ranking, annual mean diurnal raptor use at the Project (0.2 – 0.5 raptors/800-m plot/20-min survey) is low. In addition, raptor use was lowest during the spring and fall migration seasons and therefore the Project did not experience high raptor use during migration.

Eagles

Bald eagles were recorded using the Project during all seasons; however, observations within the zone of risk (below 200m) were concentrated near an active bald eagle nest in the northern portion of the Project (Figure 3). Seventy-two percent of all bald eagle risk minutes were observed at points 1 and 2, which were located within 2.0 mi (3.2 km) of the northern nest suggesting the use of the Project by eagles is concentrated near active eagle nests. There are no other landscape features within the Project that appear to concentrate eagle use.

Golden eagles are rare in the Midwest and eastern US, as they are most commonly found west of Texas and nest in Alaska and Canada. No golden eagles were observed within the Project during the 268 hours of eagle surveys or incidentally. The risk of mortality to golden eagles is considered low and unlikely to occur.

Sensitive Species

No federally listed or BCC species were observed during surveys, suggesting low risk to these species at the Project. Northern harriers were observed within the Project and are also commonly observed during avian use surveys at wind energy facilities, yet no fatalities of this species have been recorded in the Midwest (See Appendix E for a list of facilities and references). The lack of fatalities is likely due to the northern harrier's hunting and flight habits. Northern harriers generally hunt and fly at low elevations, and therefore, have a low risk of collision with modern wind turbines (Whitfield and Madders 2005). All of the northern harriers were observed flying below the RSH during the 20-min large bird surveys. Northern harriers were more commonly observed in the winter, but some use was recorded during the spring and summer. Northern harrier breeding habitat is rare within the Project with less than 1% of the Project classified as hayfields/pasture, and there are no grasslands according to NLCD data (USGS NLCD 2011, Homer et al. 2015).

CONCLUSIONS

Analysis of the data collected during the surveys generally indicates that development of the Project is not likely to cause significant impacts to large bird populations, including diurnal raptors or sensitive species. The majority of species observed are widespread and abundant, suggesting low risk of adverse impacts to large bird populations. The only sensitive species observed was the northern harrier, but all of the observations were recorded below the RSH.

Bald eagles were recorded using the Project during all seasons, and use during surveys was concentrated near known eagle nests. The presence of an active bald eagle nest within the Project may warrant management consideration such as avoiding siting turbines in close proximity to the nest to reduce potential collision risk. No other features within the Project appear to concentrate eagles.

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Appendix A. Species Observed at the Emerson Creek Wind Project from September 30, 2016 – December 18, 2017

Appendix A. Summary of individuals (obs) and group (grps) observations within 800 m by bird type and species for 20-min large bird use surveys at the Emerson Wind Project from September 30, 2016 – December 18, 2017.

		Spring		Summer		Fall		Winter		Total	
Type/Species	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Waterbirds		**4**	**4**	**6**	**9**	**1**	**1**	**0**	**0**	**11**	**14**
great blue heron	*Ardea herodias*	2	2	3	4	1	1	0	0	6	7
great egret	*Ardea alba*	2	2	3	5	0	0	0	0	5	7
Waterfowl		**3**	**7**	**0**	**0**	**0**	**0**	**10**	**2,441**	**13**	**2,448**
Canada goose	*Branta canadensis*	2	5	0	0	0	0	7	2,210	9	2,215
mallard	*Anas platyrhynchos*	1	2	0	0	0	0	0	0	1	2
tundra swan	*Cygnus columbianus*	0	0	0	0	0	0	3	231	3	231
Shorebirds		**16**	**29**	**14**	**18**	**7**	**27**	**1**	**2**	**38**	**76**
killdeer	*Charadrius vociferus*	16	29	14	18	7	27	1	2	38	76
Gulls/Terns		**2**	**2**	**0**	**0**	**0**	**0**	**1**	**1**	**3**	**3**
Herring gull	*Larus argentatus*	1	1	0	0	0	0	1	1	2	2
ring-billed gull	*Larus delawarensis*	1	1	0	0	0	0	0	0	1	1
Diurnal Raptors		**24**	**28**	**22**	**24**	**9**	**10**	**29**	**34**	**84**	**96**
Accipiters		0	0	2	2	0	0	3	3	5	5
Cooper's hawk	*Accipiter cooperii*	0	0	2	2	0	0	2	2	4	4
sharp-shinned hawk	*Accipiter striatus*	0	0	0	0	0	0	1	1	1	1
Buteos		7	10	7	9	4	4	15	19	33	42
red-tailed hawk	*Buteo jamaicensis*	7	10	7	9	4	4	15	19	33	42
Northern Harrier		3	3	1	1	0	0	6	6	10	10
northern harrier	*Circus cyaneus*	3	3	1	1	0	0	6	6	10	10
Eagles		13	14	9	9	1	1	3	4	26	28
bald eagle	*Haliaeetus leucocephalus*	13	14	9	9	1	1	3	4	26	28
Falcons		1	1	3	3	4	5	2	2	10	11
American kestrel	*Falco sparverius*	1	1	3	3	4	5	2	2	10	11
Owls		**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**
snowy owl	*Bubo scandiacus*	1	1	0	0	0	0	0	0	1	1
Vultures		**10**	**14**	**28**	**52**	**11**	**12**	**0**	**0**	**49**	**78**
turkey vulture	*Cathartes aura*	10	14	28	52	11	12	0	0	49	78
Doves/Pigeons		**11**	**19**	**15**	**25**	**6**	**40**	**8**	**64**	**40**	**148**
mourning dove	*Zenaida macroura*	8	13	13	21	4	7	4	30	29	71
rock pigeon	*Columba livia*	3	6	2	4	2	33	4	34	11	77
Large Corvids		**7**	**10**	**2**	**4**	**7**	**23**	**9**	**16**	**25**	**53**
American crow	*Corvus brachyrhynchos*	7	10	2	4	7	23	9	16	25	53
Overall	**19 species**	**78**	**114**	**87**	**132**	**43**	**120**	**58**	**2,558**	**266**	**2,924**

Appendix B. Mean Use, Percent of Use, and Frequency of Occurrence for Large Birds Observed during Large bird Use Surveys at the Emerson Creek Wind Project from September 30, 2016 – December 18, 2017

Appendix B. Mean large bird use (number of large birds/800-m plot/20-min survey), percent of total use (%), and frequency of occurrence (%) for each large bird type and species by season during large bird use surveys at the Emerson Creek Wind Project from September 30, 2016 – December 18, 2017.

	Mean Use				% of Use				% Frequency			
Type/Species	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**
Waterbirds	**0.06**	**0.13**	**<0.01**	**0**	**3.6**	**6.9**	**0.5**	**0**	**5.8**	**8.7**	**0.9**	**0**
great blue heron	0.03	0.06	<0.01	0	1.8	3.1	0.5	0	2.9	4.3	0.9	0
great egret	0.03	0.07	0	0	1.8	3.8	0	0	2.9	4.3	0	0
Waterfowl	**0.1**	**0**	**0**	**26.72**	**6.4**	**0**	**0**	**91.6**	**4.3**	**0**	**0**	**6.6**
Canada goose	0.07	0	0	24.1	4.5	0	0	82.6	2.9	0	0	5.5
mallard	0.03	0	0	0	1.8	0	0	0	1.4	0	0	0
tundra swan	0	0	0	2.62	0	0	0	9	0	0	0	3.4
Shorebirds	**0.42**	**0.26**	**0.36**	**0.02**	**26.4**	**13.7**	**20.2**	**<0.1**	**18.8**	**20.3**	**7**	**1.1**
killdeer	0.42	0.26	0.36	0.02	26.4	13.7	20.2	<0.1	18.8	20.3	7	1.1
Gulls/Terns	**0.03**	**0**	**0**	**0.01**	**1.8**	**0**	**0**	**<0.1**	**2.9**	**0**	**0**	**1.1**
Herring gull	0.01	0	0	0.01	0.9	0	0	<0.1	1.4	0	0	1.1
ring-billed gull	0.01	0	0	0	0.9	0	0	0	1.4	0	0	0
Diurnal Raptors	**0.35**	**0.33**	**0.09**	**0.34**	**21.8**	**17.6**	**5.3**	**1.2**	**24.6**	**29**	**8.5**	**25.3**
Accipiters	0	0.03	0	0.03	0	1.5	0	0.1	0	2.9	0	3.3
Cooper's hawk	0	0.03	0	0.02	0	1.5	0	<0.1	0	2.9	0	2.2
sharp-shinned hawk	0	0	0	0.01	0	0	0	<0.1	0	0	0	1.1
Buteos	0.14	0.13	0.04	0.21	9.1	6.9	2.3	0.7	10.1	10.1	4.1	15.4
red-tailed hawk	0.14	0.13	0.04	0.21	9.1	6.9	2.3	0.7	10.1	10.1	4.1	15.4
Northern Harrier	0.04	0.01	0	0.07	2.7	0.8	0	0.2	4.3	1.4	0	5.5
northern harrier	0.04	0.01	0	0.07	2.7	0.8	0	0.2	4.3	1.4	0	5.5
Eagles	0.14	0.12	<0.01	0.01	9.1	6.1	0.5	<0.1	10.1	10.1	0.9	1.1
bald eagle	0.14	0.12	<0.01	0.01	9.1	6.1	0.5	<0.1	10.1	10.1	0.9	1.1
Falcons	0.01	0.04	0.04	0.02	0.9	2.3	2.5	<0.1	1.4	4.3	3.6	2.3
American kestrel	0.01	0.04	0.04	0.02	0.9	2.3	2.5	<0.1	1.4	4.3	3.6	2.3
Owls	**0.01**	**0**	**0**	**0**	**0.9**	**0**	**0**	**0**	**1.4**	**0**	**0**	**0**
snowy owl	0.01	0	0	0	0.9	0	0	0	1.4	0	0	0
Vultures	**0.2**	**0.75**	**0.12**	**0**	**12.7**	**39.7**	**6.8**	**0**	**11.6**	**31.9**	**9.8**	**0**
turkey vulture	0.2	0.75	0.12	0	12.7	39.7	6.8	0	11.6	31.9	9.8	0
Doves/Pigeons	**0.28**	**0.36**	**0.36**	**0.71**	**17.3**	**19.1**	**20.2**	**2.4**	**14.5**	**20.3**	**5.3**	**5.5**
mourning dove	0.19	0.3	0.06	0.34	11.8	16	3.4	1.2	10.1	17.4	3.5	2.2
rock pigeon	0.09	0.06	0.3	0.37	5.5	3.1	16.8	1.3	4.3	2.9	1.8	3.3
Large Corvids	**0.14**	**0.06**	**0.84**	**1.37**	**9.1**	**3.1**	**47**	**4.7**	**10.1**	**2.9**	**25.5**	**33.9**
American crow	0.14	0.06	0.84	1.37	9.1	3.1	47	4.7	10.1	2.9	25.5	33.9
Overall	**1.59**	**1.9**	**1.78**	**29.17**	**100**	**100**	**100**	**100**				

Appendix C. Overall Mean Use by Point for All Large Birds and Major Large Bird Types during Large Bird Use Surveys at the Emerson Creek Wind Project from September 30, 2016 – December 18, 2017

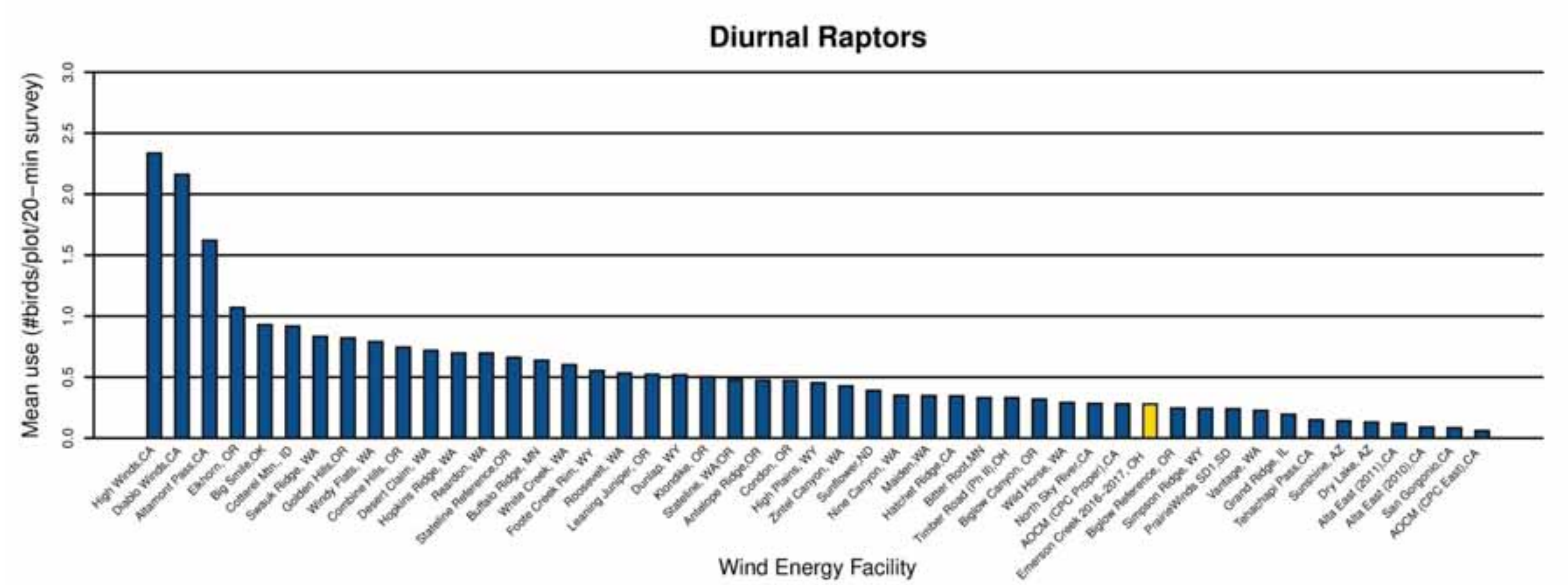
Appendix C. Overall mean use for large birds (number of birds/800-m plot/20-min survey) by point for all major large bird types observed at the Emerson Creek Wind Project from September 30, 2016 – December 18, 2017.

	Survey Point													
Bird Type	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Waterbirds	0.17	0	0	0	0	0	0.42	0	0.08	0	0.08	0	0.09	0
Waterfowl	0	0	2	0	0	117.08	0	0.33	0	0	0	0	0	0
Shorebirds	0	0	1	0	0.08	2.08	0.08	0.17	0	0	0.08	0.33	0	0.08
Gulls/Terns	0	0	0	0	0	0.08	0	0	0	0	0.08	0	0	0
Diurnal Raptors	0.42	0.58	0.17	0.33	0.33	0.33	0.33	0.42	0.42	0.58	0.58	0.33	0	0
Accipiters	0.08	0	0	0.08	0	0	0	0	0	0.08	0.08	0	0	0
Buteos	0	0.08	0.08	0.17	0.33	0.17	0.25	0.08	0.25	0.25	0.5	0.25	0	0
Northern Harrier	0.17	0	0.08	0	0	0	0	0.25	0.08	0.08	0	0	0	0
Eagles	0.17	0.5	0	0.08	0	0.08	0.08	0	0	0	0	0	0	0
Falcons	0	0	0	0	0	0.08	0	0.08	0.08	0.17	0	0.08	0	0
Owls	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vultures	0	0	0.17	0.25	0.25	0.42	0.5	0	0.17	0.5	0.17	0.08	0.64	0.58
Doves/Pigeons	3.17	0.08	0.17	0	0	0.25	1.75	0	0.25	0.42	2.75	0.33	0.18	0.17
Large Corvids	0.08	0	0	1.42	0	0.08	0.08	0.25	0	0.08	0.17	0	0	0.33
All Large Birds	**3.83**	**0.67**	**3.5**	**2**	**0.67**	**120.33**	**3.17**	**1.17**	**0.92**	**1.58**	**3.92**	**1.08**	**0.91**	**1.17**

Appendix C (*continued*). Mean use for large birds (number of birds/800-m plot/20-min survey) by point for all major large bird types observed at the Emerson Creek Wind Project from September 30, 2016 – December 18, 2017.

	Survey Point								
Bird Type	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**40**
Waterbirds	0	0.09	0	0	0	0	0	0.27	0
Waterfowl	0	0	0.18	91.91	0	0	0	0.18	0
Shorebirds	0.27	0	0.55	0.09	0.09	0.36	0.25	0.55	0.42
Gulls/Terns	0	0	0	0.09	0	0	0	0	0
Diurnal Raptors	0.36	0.36	0.18	0.36	0.18	0.64	0.08	0.09	0.42
Accipiters	0	0	0.09	0	0	0	0	0	0
Buteos	0.18	0.27	0.09	0.18	0.09	0.27	0.08	0	0
Northern Harrier	0	0	0	0	0	0.09	0	0	0.08
Eagles	0	0	0	0.18	0.09	0.27	0	0	0.25
Falcons	0.18	0.09	0	0	0	0	0	0.09	0.08
Owls	0	0	0	0.09	0	0	0	0	0
Vultures	0.18	0.09	0.18	0.45	0.36	0.27	0.5	0.27	0.5
Doves/Pigeons	0.09	0	0	0.27	1.64	0.55	0	0.27	0.25
Large Corvids	0	0	0.27	0	0.09	0.27	0	0.64	0.75
All Large Birds	**0.91**	**0.55**	**1.36**	**93.27**	**2.36**	**2.09**	**0.83**	**2.27**	**2.33**

Appendix D. Comparison of Diurnal Raptor Use at North American Wind Energy Facilities



Appendix D. Comparison of annual diurnal raptor use during large bird and eagle use surveys at the Emerson Creek Project from October 3, 2016 – September 14, 2017, and annual diurnal raptor use recorded at other North American wind energy facilities.

Data from the following sources:

Study and Location	Reference	Study and Location	Reference	Study and Location	Reference
Emerson Creek, OH	This study.				
High Winds, CA	Kerlinger et al. 2005	Foote Creek Rim, WY	Johnson et al. 2000b	Wild Horse, WA	Erickson et al. 2003d
Diablo Winds, CA	WEST 2006	Roosevelt, WA	NWC and WEST 2004	North Sky River, CA	Erickson et al. 2011
Altamont Pass, CA	Orloff and Flannery 1992	Leaning Juniper, OR	Kronner et al. 2005	AOCM (CPC Proper), CA	Chatfield et al. 2010
Elkhorn, OR	WEST 2005a	Dunlap, WY	Johnson et al. 2009a	Biglow Reference, OR	WEST 2005c
Big Smile (Dempsey), OK	Derby et al. 2010b	Klondike, OR	Johnson et al. 2002	Simpson Ridge, WY	Johnson et al. 2000b
Cotterel Mtn., ID	BLM 2006	Stateline, WA/OR	Erickson et al. 2003b	Vantage, WA	Jeffrey et al. 2007
Swauk Ridge, WA	Erickson et al. 2003c	Antelope Ridge, OR	WEST 2009	Grand Ridge, IL	Derby et al. 2009
Golden Hills, OR	Jeffrey et al. 2008	Condon, OR	Erickson et al. 2002b	Tehachapi Pass, CA	Anderson et al. 2000, Erickson et al. 2002b
Windy Flats, WA	Johnson et al. 2007	High Plains, WY	Johnson et al. 2009b	Sunshine, AZ	WEST and the CPRS 2006
Combine Hills, OR	Young et al. 2003a	Zintel Canyon, WA	Erickson et al. 2002a, 2003a	Dry Lake, AZ	Young et al. 2007b
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. 2007a	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		

Appendix E. Midwest Raptor Fatality Summary Table

Appendix E. Wind energy facilities in the Midwest region of North America with comparable use and fatality data for diurnal raptors.

Project Name	Use Estimate[A]	Raptor Fatality Estimate[B]	No. of Turbines	Total MW
Emerson Creek, OH (2016-2017)	**0.39**			
		Midwest		
Buffalo Ridge, MN (Phase I; 1999)	NA	0.47	73	25
Moraine II, MN (2009)	NA	0.37	33	49.5
Winnebago, IA (2009-2010)	NA	0.27	10	20
Buffalo Ridge I, SD (2009-2010)	NA	0.2	24	50.4
Cedar Ridge, WI (2009)	NA	0.18	41	67.6
PrairieWinds SD1, SD (2013-2014)	NA	0.17	108	162
Top of Iowa, IA (2004)	NA	0.17	89	80
Cedar Ridge, WI (2010)	NA	0.13	41	68
Ripley, Ont (2008)	NA	0.1	38	76
Wessington Springs, SD (2010)	0.232	0.07	34	51
Rugby, ND (2010-2011)	NA	0.06	71	149
NPPD Ainsworth, NE (2006)	NA	0.06	36	20.5
Wessington Springs, SD (2009)	0.232	0.06	34	51
PrairieWinds ND1 (Minot), ND (2011)	NA	0.05	80	115.5
PrairieWinds ND1 (Minot), ND (2010)	NA	0.05	80	115.5
PrairieWinds SD1, SD (2012-2013)	NA	0.03	108	162
Elm Creek, MN (2009-2010)	NA	0	67	100
Rail Splitter, IL (2012-2013)	NA	0	67	100.5
Pioneer Prairie II, IA (2011-2012)	NA	0	62	102.3
Buffalo Ridge, MN (Phase III; 1999)	NA	0	138	103.5
Buffalo Ridge, MN (Phase II; 1998)	NA	0	143	107.25
Buffalo Ridge, MN (Phase II; 1999)	NA	0	143	107.25
Blue Sky Green Field, WI (2008; 2009)	NA	0	88	145
Elm Creek II, MN (2011-2012)	NA	0	62	148.8
Barton I & II, IA (2010-2011)	NA	0	80	160
PrairieWinds SD1, SD (2011-2012)	NA	0	108	162
Kewaunee County, WI (1999-2001)	NA	0	31	20.46
Buffalo Ridge II, SD (2011-2012)	NA	0	105	210
Buffalo Ridge, MN (Phase I; 1996)	NA	0	73	25
Buffalo Ridge, MN (Phase I; 1997)	NA	0	73	25
Buffalo Ridge, MN (Phase I; 1998)	NA	0	73	25
Fowler I, IN (2009)	NA	0	162	301
Big Blue, MN (2013)	NA	0	18	36
Big Blue, MN (2014)	NA	0	18	36
Top of Iowa, IA (2003)	NA	0	89	80
Grand Ridge I, IL (2009-2010)	0.195	0	66	99

A=number of raptors/plot/20min survey
B=number of fatalities/MW/year

MW = megawatts; NA = not available

Appendix E (*continued*). Wind energy facilities in the Midwest region of North America with comparable use and fatality data for diurnal raptors. Data from the following sources:

Project Name	Use Reference	Fatality Reference	Project Name	Use Reference	Fatality Reference
Emerson Creek, OH (16-17)	This study				
Barton I & II, IA (2010-2011)	NA	Derby et al. 2011b	Grand Ridge I, IL (2009-2010)	Derby et al. 2009	Derby et al. 2010a
Big Blue, MN (2013)	NA	Fagen Engineering 2014	Kewaunee County, WI (1999-2001)	NA	Howe et al. 2002
Big Blue, MN (2014)	NA	Fagen Engineering 2015	Moraine II, MN (2009)	NA	Derby et al. 2010g
Blue Sky Green Field, WI (2008; 2009)	NA	Gruver et al. 2009	NPPD Ainsworth, NE (2006)	NA	Derby et al. 2007
Buffalo Ridge, MN (Phase I; 1996)	NA	Johnson et al. 2000a	Pioneer Prairie II, IA (2011-2012)	NA	Chodachek et al. 2012
Buffalo Ridge, MN (Phase I; 1997)	NA	Johnson et al. 2000a	PrairieWinds ND1 (Minot), ND (2010)	NA	Derby et al. 2011d
Buffalo Ridge, MN (Phase I; 1998)	NA	Johnson et al. 2000a	PrairieWinds ND1 (Minot), ND (2011)	NA	Derby et al. 2012c
Buffalo Ridge, MN (Phase I; 1999)	NA	Johnson et al. 2000a	PrairieWinds SD1, SD (2011-2012)	NA	Derby et al. 2012d
Buffalo Ridge, MN (Phase II; 1998)	NA	Johnson et al. 2000a	PrairieWinds SD1, SD (2012-2013)	NA	Derby et al. 2013
Buffalo Ridge, MN (Phase II; 1999)	NA	Johnson et al. 2000a	PrairieWinds SD1, SD (2013-2014)	NA	Derby et al. 2014
Buffalo Ridge, MN (Phase III; 1999)	NA	Johnson et al. 2000a	Rail Splitter, IL (2012-2013)	NA	Good et al. 2013a
Buffalo Ridge I, SD (2009-2010)	NA	Derby et al. 2010e	Ripley, Ont (2008)	NA	Jacques Whitford 2009
Buffalo Ridge II, SD (2011-2012)	NA	Derby et al. 2012a	Rugby, ND (2010-2011)	NA	Derby et al. 2011c
Cedar Ridge, WI (2009)	NA	BHE Environmental 2010	Top of Iowa, IA (2003)	NA	Jain 2005
Cedar Ridge, WI (2010)	NA	BHE Environmental 2011	Top of Iowa, IA (2004)	NA	Jain 2005
Elm Creek, MN (2009-2010)	NA	Derby et al. 2010f	Wessington Springs, SD (2009)	Derby et al. 2008	Derby et al. 2010d
Elm Creek II, MN (2011-2012)	NA	Derby et al. 2012b	Wessington Springs, SD (2010)	NA	Derby et al. 2011a
Fowler I, IN (2009)	NA	Johnson et al. 2010	Winnebago, IA (2009-2010)	NA	Derby et al. 2010h

Appendix F. Summary of Publicly Available Studies at Midwestern Wind Energy Facilities That Report Bird Fatalities

Appendix F. Summary of publicly available studies at Midwestern wind energy facilities that report bird fatalities.

Project Name	Reference	Project	Reference
Barton I & II, IA (10-11)	Derby et al. 2011b	Fowler III, IN (09)	Johnson et al. 2010b
Big Blue, MN (13)	Fagen Engineering 2014	Grand Ridge I, IL (09-10)	Derby et al. 2010a
Big Blue, MN (14)	Fagen Engineering 2015	Harrow, Ont (10)	Natural Resources Solutions Inc. (NRSI) 2011
Blue Sky Green Field, WI (08; 09)	Gruver et al. 2009	Heritage Garden I, MI (12-14)	Kerlinger et al. 2014
Buffalo Ridge, MN (94-95)	Osborn et al. 1996, Osborn et al. 2000	Heritage Garden I, MI (12-14)	Kerlinger et al. 2014
Buffalo Ridge, MN (00)	Krenz and McMillan	Kewaunee County, WI (99-01)	Howe et al. 2002
Buffalo Ridge, MN (Phase I; 96)	Johnson et al. 2000	Lakefield Wind, MN (12)	Minnesota Public Utilities Commission (MPUC). 2012
Buffalo Ridge, MN (Phase I; 97)	Johnson et al. 2000	Melancthon, Ont (Phase I; 07)	Stantec Ltd. 2008
Buffalo Ridge, MN (Phase I; 98)	Johnson et al. 2000	Moraine II, MN (09)	Derby et al. 2010g
Buffalo Ridge, MN (Phase I; 99)	Johnson et al. 2000	NPPD Ainsworth, NE (06)	Derby et al. 2007
Buffalo Ridge, MN (Phase II; 98)	Johnson et al. 2000	Pioneer Prairie II, IA (11-12)	Chodachek et al. 2012
Buffalo Ridge, MN (Phase II; 99)	Johnson et al. 2000	Pioneer Prairie II, IA (13)	Chodachek et al. 2014
Buffalo Ridge, MN (Phase II; 01/Lake Benton I)	Johnson et al. 2004	Pioneer Trail, IL (12-13)	ARCADIS U.S., Inc. 2013
Buffalo Ridge, MN (Phase II; 02/Lake Benton I)	Johnson et al. 2004	Prairie Rose, MN (14)	Chodachek et al. 2015
Buffalo Ridge, MN (Phase III; 99)	Johnson et al. 2000	PrairieWinds SD1, SD (12-13)	Derby et al. 2013
Buffalo Ridge, MN (Phase III; 01/Lake Benton II)	Johnson et al. 2004	PrairieWinds SD1, SD (13-14)	Derby et al. 2014
Buffalo Ridge, MN (Phase III; 02/Lake Benton II)	Johnson et al. 2004	PrairieWinds ND1 (Minot), ND (10)	Derby et al. 2011d
Buffalo Ridge I, SD (09-10)	Derby et al. 2010e	PrairieWinds ND1 (Minot), ND (11)	Derby et al. 2012c
Buffalo Ridge II, SD (11-12)	Derby et al. 2012	PrairieWinds SD1, SD (11-12)	Derby et al. 2012d
Cedar Ridge, WI (09)	BHE Environmental 2010	Rail Splitter, IL (12-13)	Good et al. 2013b
Cedar Ridge, WI (10)	BHE Environmental 2011	Ripley, Ont (08)	Jacques Whitford 2009
Crescent Ridge, IL (05-06)	Kerlinger et al. 2007	Ripley, Ont (08-09)	Golder Associates 2010
Crystal Lake II, IA (09)	Derby et al. 2010c	Rugby, ND (10-11)	Derby et al. 2011c
Elm Creek, MN (09-10)	Derby et al. 2010f	Top Crop I & II (12-13)	Good et al. 2013b
Elm Creek II, MN (11-12)	Derby et al. 2012	Top of Iowa, IA (03)	Jain 2005
Forward Energy Center, WI (08-10)	Grodsky and Drake 2011	Top of Iowa, IA (04)	Jain 2005
Fowler I, IN (09)	Johnson et al. 2010a	Wessington Springs, SD (09)	Derby et al. 2010d
Fowler I, II, III, IN (10)	Good et al. 2011	Wessington Springs, SD (10)	Derby et al. 2011a
Fowler I, II, III, IN (11)	Good et al. 2012	Winnebago, IA (09-10)	Derby et al. 2010h

Exhibit S
Raptor Migration/Use Surveys

2. Large Bird and Eagle Use Surveys for the Emerson Creek Wind Project Huron County, Ohio dated September 10, 2018

Christine M.T. Pirik (0029759)
(Counsel of Record)
Terrence O'Donnell (0074213)
William V. Vorys (0093479)
Dickinson Wright PLLC
150 East Gay Street, Suite 2400
Columbus, Ohio 43215
Phone: (614) 591-5461
Email: cpirik@dickinsonwright.com
todonnell@dickinsonwright.com
wvorys@dickinsonwright.com

Attorneys for Firelands Wind, LLC

Large Bird and Eagle Use Surveys for the Emerson Creek Wind Project Huron County, Ohio

September 16, 2016 – December 18, 2017

Prepared by:

Goniela Iskali and Chad LeBeau

Western EcoSystems Technology, Inc.

408 West Sixth Street
Bloomington, Indiana 47404

September 10, 2018

EXECUTIVE SUMMARY

Western EcoSystems Technology, Inc. completed year-round large bird and eagle use surveys for the proposed Emerson Creek Wind Project (Project) in Huron County, Ohio. The objectives of the large bird and eagle use point count surveys were to: 1) provide estimates of large bird use throughout the year; 2) evaluate species composition and seasonal and spatial use by birds, including special status species; 3) assess raptor migration during the spring and fall seasons; and 4) assess risk to eagles and special status species. The surveys were completed in coordination with the US Fish and Wildlife Service (USFWS) and Ohio Department of Natural Resources (ODNR) and in accordance with the tiered process outlined in the USFWS final *Land-Based Wind Energy Guidelines,* USFWS *Eagle Conservation Plan Guidance*, and ODNR *On-Shore Bird and Bat Pre- and Post-Construction Monitoring Protocol for Commercial Wind Energy Facilities in Ohio*.

Surveys were completed monthly from September 16, 2016, to December 18, 2017, at 21 points established throughout the Project area. Surveys were 60-minute (min) in duration and consisted of large bird and eagle use surveys within an 800-meter (m; 2,625-foot) radius of the surveyor. All large birds were recorded during the first 20 min of each 60-min count, while only eagles and federal- and/or state-listed species were recorded for the remaining 40 min. Federal- and state-listed species and eagles were recorded as incidental observations while in-transit between survey points, if observed.

A total of 17 species (793 observations) were recorded during the 20-min large bird surveys, of which five species were diurnal raptors. Seasonal diurnal raptor use was similar among seasons, ranging from a low of 0.30 bird/800-m plot/20-min survey (spring) to a high of 0.49 (fall). Diurnal raptor use was low overall compared to other projects with publicly available data where diurnal raptor use ranged from 0.06 to 2.34 raptors/800-m plot/20-min survey. Raptor migration during the spring and fall does not appear to be concentrated within the Project as diurnal raptor use was similar among spring, summer and winter and lowest during the fall.

A total of 17 bald eagle observations were recorded during 252 hours of survey across approximately 15 months. A total of 17 eagle risk minutes, as defined by the ECPG, were recorded, of which 5 mins (29%) were recorded near point 41, which is near an active bald eagle nest within the Project. The majority (47%) of eagle observations were recorded during the summer.

No federally threatened or endangered species were observed during the surveys. One state endangered species (northern harrier) was recorded during the surveys (n=13). The majority of the northern harrier observations (75%) were recorded below the rotor-swept height. Northern harrier use of the Project was low during the summer breeding period which is likely the result of limited breeding habitat within the Project due to the amount of cultivated croplands present. In addition, one red-headed woodpecker, a USFWS Birds of Conservation Concern species, was observed during surveys. Overall, the Project presents species composition and seasonal and

spatial use patterns for birds typical for the region and is not likely to cause significant impacts to large bird populations, including diurnal raptors and special-status species.

STUDY PARTICIPANTS

Western EcoSystems Technology, Inc.

Goniela Iskali	Project Manager
Chad LeBeau	Senior Reviewer
Karl DuBridge	Field Supervisor and Report Compiler
Carmen Boyd	Project Tracking and Data Manager
Mandy Kauffman	Statistician
Carissa Goodman	Data Analyst
Jeff Fruhwirth	GIS Technician
Wendy Bruso	Technical Editing Manager
Katie Wynne	Technical Editing Coordinator
Dave Klein	Technical Editor
Andrea Palochak	Technical Editor
Dan Kramer	Field Technician

REPORT REFERENCE

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INTRODUCTION

This report presents the results of the 2016 – 2017 large bird and eagle use surveys completed by Western EcoSystems Technology, Inc. (WEST) for the Emerson Creek Wind Project (Project) located in Huron County, Ohio. Survey protocols were developed in coordination with the US Fish and Wildlife Service (USFWS) and Ohio Department of Natural Resources (ODNR), and were consistent with recommendations within the final *Land-Based Wind Energy Guidelines* (USFWS 2012), and the USFWS *Eagle Conservation Plan Guidance* (ECPG; USFWS 2013 and 2016b). The objectives of the surveys were to: 1) provide estimates of large bird use throughout the year; 2) evaluate species composition and seasonal and spatial use by bird, including special status species; 3) assess raptor migration during the spring and fall seasons; and 4) assess risk to eagles and special status species.

PROJECT AREA

The proposed 122.8-square kilometer (km^2; 30,352 acre) Project is located 2.24 km (1.4 mile [mi]) east of Willard, Ohio. According to the National Land Cover Dataset (NLCD), the Project area is dominated by croplands (80.1%; Table 1, Figure 1; US Geological Survey [USGS] NLCD 2011, Homer et al. 2015) with corn (*Zea mays*) and soybeans (*Glycine max*) being the main crops grown. Deciduous forests (13.5%), developed areas (4.9%) and hay/pasture (1.2%) are the next most common land cover types within the Project area (Table 1). All other land cover types compose 1.0% or less of the Project, combined (Table 1, Figure 1).

Table 1. Land cover types and composition at the Emerson Creek Wind Project.

Habitat	Acres	% Composition
Cultivated Crops	24,307	80.1
Deciduous Forest	4,091	13.5
Developed	1,496	4.9
Hay/Pasture	363	1.2
Herbaceous	66	0.2
Open Water	17	0.1
Evergreen Forest	8	<0.1
Mixed Forest	3	<0.1
Woody Wetlands	1	<0.1
Total	**30,352**	**100**

Data from USGS NLCD 2011, Homer et al. 2015.

Values may not add up due to rounding.

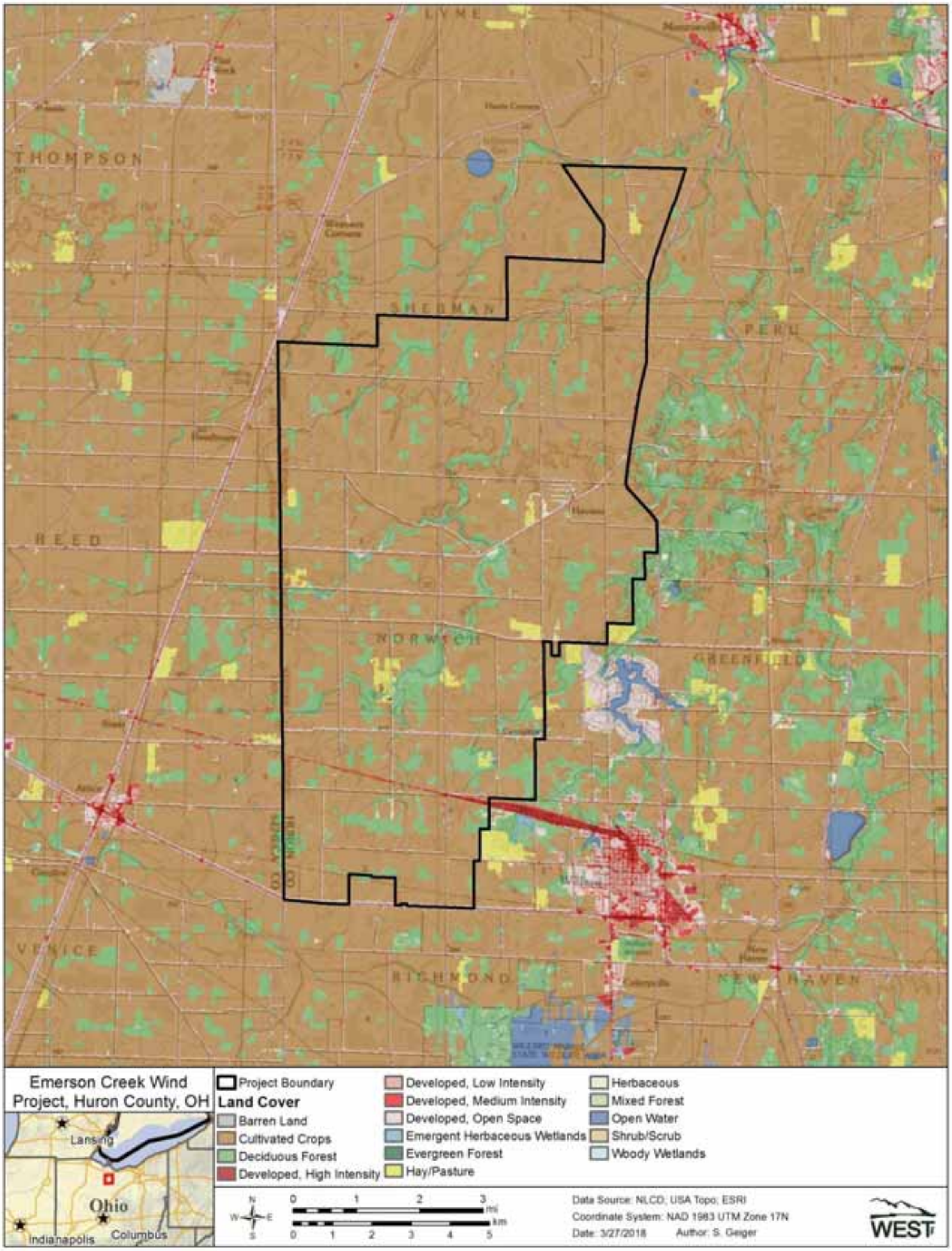

Figure 1. Land cover within the Emerson Creek Wind Project (USGS NLCD 2011, Homer et al. 2015) in Huron County, Ohio.

METHODS

Large bird and eagle use surveys were completed monthly for a full year at 21 points throughout the Project from September 16, 2016, to December 18, 2017, in accordance with methods described by Reynolds et al. (1980). Most points were surveyed from September 2016 to September 2017, but points 39, 41 and 42 were added in January 2017 due to a Project expansion and surveyed for a full year until December 18, 2017 (Figure 2). Each survey point was located to maximize viewshed for the observer and to enable evaluation of representative habitats within and near the Project. The 800-meter (m; 2,625 feet [ft]) radius plots used in this evaluation are representative of potential development areas and encompassed approximately 30% of the Project as currently proposed.

Each survey point was surveyed for a total of 60 minutes (min). The large bird use surveys were completed during the first 20 mins, during which all large birds within 800 m were recorded. The eagle use survey was completed for the entire 60-min period, during which all eagles within 800 m of the observer were recorded.

For purposes of this study, large birds were defined as waterbirds, waterfowl, shorebirds, diurnal raptors (kites, accipiters, buteos, eagles, falcons, northern harrier, and osprey), vultures, upland game birds, doves and pigeons, large corvids, and goatsuckers. The 20-min portion of the survey allowed for standardization and comparison of data with other wind energy facilities throughout the region, while the 60-min eagle counts allowed for more robust evaluation of bald (*Haliaeetus leucocephalus*) and golden eagle (*Aquila chrysaetos*) use of the site in accordance with the USFWS ECPG (USFWS 2013). In addition, these surveys were used to assess raptor migration during the spring (March 15 – May 1) and fall (September 1 – October 31) in accordance with ODNR Protocols and as agreed upon with ODNR.

Observations of special status species (defined as species afforded protection under the Endangered Species Act [1973], Bald and Golden Eagle Protection Act [1940], listed as threatened or endangered by the state of Ohio [ODNR 2016], or Birds of Special Conservation Concern [USFWS 2018]) were recorded throughout the 60-min surveys. Observations of special status species beyond the 800-m radius plot and in-transit were recorded as incidental observations to document occurrence on site, but were excluded from statistical analyses of mean use.

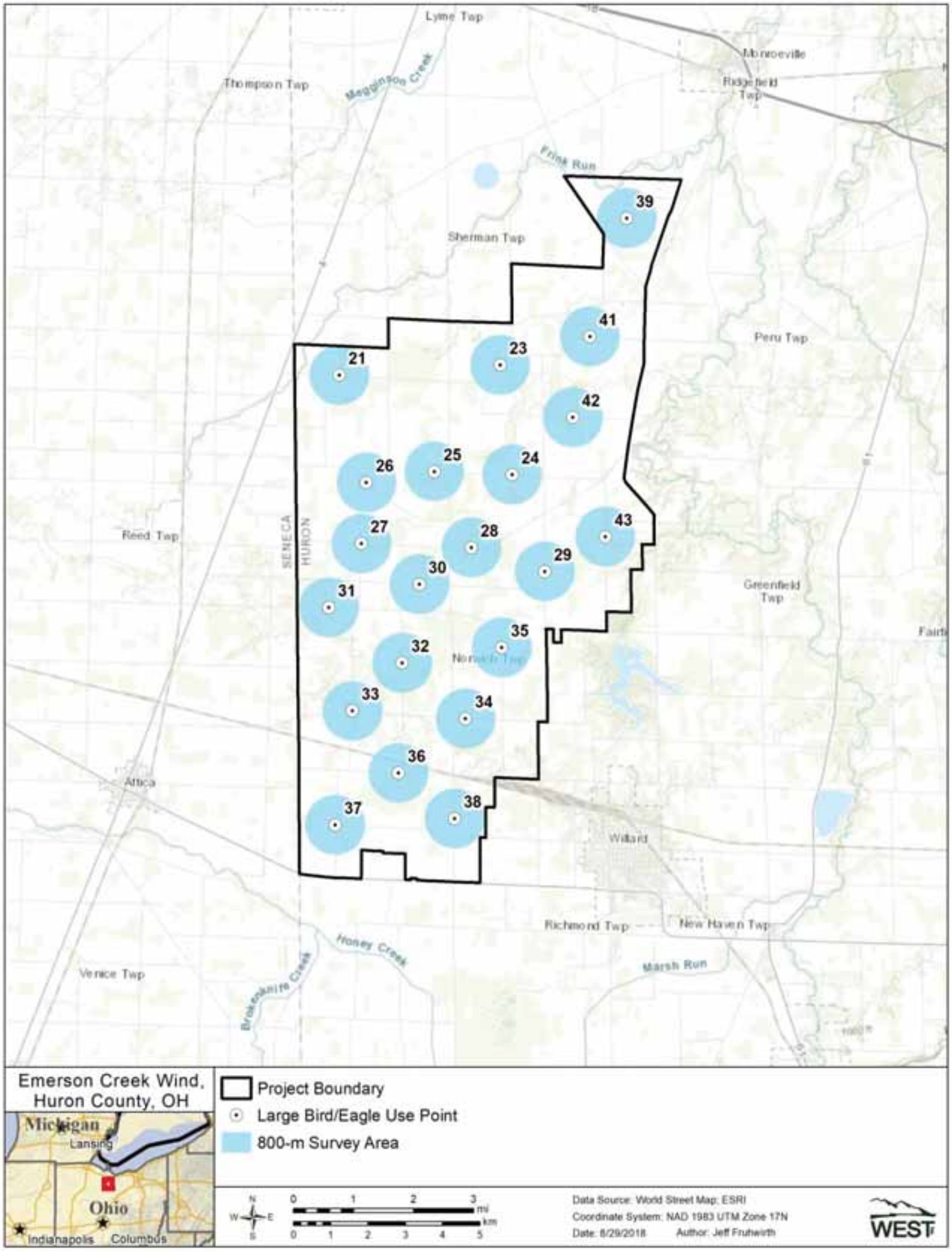

Figure 2. Observation point locations used during large bird/eagle use surveys at the Emerson Creek Wind Project from September 16, 2016 – December 18, 2017.

At each survey point, the date, start and end time of the survey period, and weather information (e.g., temperature, wind speed and direction, and cloud cover) were recorded. Species or best possible identification, number of individuals, sex and age class (if possible), distance from plot center when first observed, closest distance, flight height or altitude above ground, activity (behavior), and habitat(s) were recorded for each observation. Approximate flight height and distance from plot center at first observation were recorded to the nearest 1-m (3-ft) interval. Eagle risk minutes (i.e., minutes of eagles flying within 800 m and below 200 m [656 ft]) were documented in accordance with the ECPG. Locations of special status species were recorded on field maps by unique observation number. In addition, flight paths of eagles and special status species were recorded on aerial maps and labeled by the unique observation number corresponding to the mapped individual.

Statistical Analysis

Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) measures were implemented at all stages of the surveys, including in the field, during data entry and analysis, and report writing. Observers were responsible for inspecting data forms for completeness, accuracy, and legibility following each field survey. Potentially erroneous data were identified using a series of database queries. Irregular codes or data suspected as 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® SQL 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 and electronic data files were retained for reference.

Fixed-Point Count Avian Use Surveys

For analysis purposes, a visit was defined as the required length of time, in days, to survey all of the plots once within the Project. Seasons were defined as spring (March 1 to May 31), summer (June 1 to August 30), fall (September 1 to November 30), and winter (December 1 to February 28).

Bird Diversity and Species Richness

Bird diversity for all large bird use surveys was illustrated by the total number of species identified. Species lists and counts, with the number of observations and the number of groups, were generated by season and included all observations of birds detected within 800 m. In some cases, the tally of observations may represent repeated sightings of the same individual. Species richness was calculated as the mean number of species observed per plot per survey, and was compared between seasons.

Mean Use, Seasonal Variations, and Frequency of Occurrence

Large birds detected within the 800-m radius plot were used to calculate mean use and frequency of occurrence of large birds. The metric used to measure mean large bird use was number of birds per plot per 20-min survey. Seasonal large bird mean use was calculated by first averaging the total number of birds seen within each plot during a visit, then averaging across 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 use of raptors per 20-min survey was used to assess seasonal raptor use and was additionally compared to use by other wind energy projects with publically available data in the Midwest

Frequency of occurrence provides a relative measure of species exposure to the proposed facility and was calculated as the percent of surveys in which a particular bird type or species was observed.

Bird Flight Height and Behavior

The flight height recorded during the initial observation was used to calculate the percentage of birds flying within the rotor swept heights (RSH; estimated to be between 25 and 200 m [82 to 656 ft] above ground level) and mean flight height during the fixed-point count large bird use surveys. The percentage of birds flying within the RSH at any time was calculated using the lowest and highest flight heights recorded. Auditory only observations were excluded from flight height calculations.

Spatial Use and Mapping

Spatial use in the Project was evaluated by comparing mean use by point location and qualitative review of flight paths. Flight paths of all eagle and special status species were digitized and mapped in order to examine spatial patterns of use within the Project.

RESULTS

A total of 252 large bird and eagle use surveys were completed between September 16, 2016, and December 18, 2017, resulting in 84 hours of 20-min large bird use surveys and 252 hours of ECPG-level eagle use surveys[1]. Details on the number of observations and groups recorded by species within the survey plots are presented in Appendix A, and details on mean use, percent of use, and frequency of occurrence are presented in Appendices B and C.

Large Bird Use

A total of 17 species (793 individual observations) were recorded during the large bird surveys (Appendix A). Turkey vultures (*Cathartes aura*) were the most frequently recorded large birds observed (38.1%), followed by American crow (*Corvus brachyrhynchos*; 15.5%), mourning dove

[1] The fall period assessed includes mainly fall 2016 data and only three points were surveyed in the fall 2017, and therefore the use documented and inference to risk for fall only applies to fall 2016.

(*Zenaida macroura*; 9.7%) and Canada goose (*Branta Canadensis*; 8.3%). All other species accounted for approximately 5.0% or fewer of the observations, individually (Appendix A).

Overall large bird use was highest during the summer (3.91 birds/800-m plot/20-min survey), followed by spring (3.89), winter (3.10), and fall (2.26; Table 2; Appendix B). The number of species of large birds recorded was fairly consistent among season: spring (n=14), summer (n=11), fall (n=11), and winter (n=13). Large bird species richness per plot per survey was highest in the spring (1.51 species/800-m plot/20-min survey) while richness was similar during the summer (1.07), fall (1.04), and winter (1.00). Overall large bird species richness was 1.16 bird species/800-m plot/20-min survey.

No federally listed threatened or endangered large bird species were observed during the 20-min surveys or incidentally. One state-listed endangered species (ODNR 2016), northern harrier (*Circus cyaneus*), was documented during surveys (n=8). Northern harrier use was relatively low, but highest in the winter (0.04 bird/800-m plot/20-min survey) and spring (0.03), followed by summer (0.01) and fall (0.01). Eleven bald eagles in 11 groups were observed during the 20-min surveys resulting in the following mean use by season: winter (0.11 birds/800-m plot/20-min survey), summer (0.05), fall (0.01), and no use in the spring (Appendices A and B). Eagle use is discussed in more detail below and summarized with respect to the full 60-min surveys.

Diurnal Raptors

A total of five diurnal raptor species (91 observations) were documented over the course of the 20-min large bird surveys. Diurnal raptor use was similar among seasons but relatively higher during the fall (0.49 bird/800-m plot/20-min survey), followed by summer (0.42), winter (0.37) and spring (0.30; Table 2). Diurnal raptor use was primarily attributable to use of the area by red-tailed hawk (*Buteo jamaicensis*), which had the highest overall use of any diurnal raptor (Appendix B). Diurnal raptors accounted for 33.8% of large bird use in the fall, 27% in winter, 23.2% in the summer, and 22.2% in fall. Diurnal raptor use at each observation point ranged from 0.08 birds/800-m plot/20-min survey to 0.83 birds/800-m plot/20-min survey, with the higher use being recorded at points 28, 39 and 41 (Figure 2; Appendix C).

Table 2. Mean large bird use (number of birds/800-meter plot/20-minute survey), percent of total use (%), and frequency of occurrence (%) for each bird type and species by season during large bird surveys at the Emerson Creek Wind Project from September 16, 2016 – December 18, 2017.

	Mean Use				% of Use				% Frequency			
Type/Species	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**
Waterbirds	0.02	0.05	0	0.05	0.4	1.3	0	1.6	1.6	4.9	0	5.0
Waterfowl	0.43	0.12	0	0.78	11.0	3.2	0	25.2	12.7	4.2	0	13.6
Shorebirds	0.21	0.21	0.07	0.10	5.3	5.4	3.2	3.4	17.5	9.1	4.4	5.7
Gulls/Terns	0.37	0	0	0.54	9.4	0	0	17.4	3.2	0	0	2.1
Diurnal Raptors	0.30	0.42	0.49	0.37	7.8	10.7	21.8	12.0	22.2	23.2	33.8	27.0
Accipiters	0.03	0.01	0.01	0	0.8	0.3	0.6	0	3.2	1.2	1.5	0
Buteos	0.16	0.16	0.28	0.28	4.1	4	12.3	9.0	14.3	14.5	27.9	19.7
Northern Harrier	0.03	0.01	0.01	0.04	0.8	0.3	0.6	1.4	3.2	1.2	1.5	4.5
Eagles	0	0.05	0.11	<0.01	0	1.3	4.7	0.3	0	2.5	9.2	1.0
Falcons	0.08	0.18	0.08	0.04	2.0	4.7	3.4	1.3	4.8	10.5	7.7	4.0
Vultures	2.03	1.00	1.37	0.02	52.2	25.6	60.4	0.6	58.7	35.1	26.5	1.0
Doves/Pigeons	0.22	1.73	0.12	0.16	5.7	44.2	5.2	5.2	14.3	8.9	8.8	5.7
Large Corvids	0.32	0.38	0.21	1.07	8.2	9.7	9.4	34.6	14.3	15.1	16.9	38.2
Overall	**3.89**	**3.91**	**2.26**	**3.10**	**100**	**100**	**100**	**100**				

Values may not add up due to rounding.

Large Bird and Diurnal Raptor Flight Height and Behavior

During the large bird surveys, 686 large bird observations in 285 groups were recorded flying (Table 3). Overall, 74% of large bird observations were within the RSH, 21% below the RSH, and 5% flying above the RSH. Gulls/terns had the highest percentage of observations recorded within the RSH (100%), followed by vultures (87.3%). Diurnal raptors were estimated to be within the RSH 59.4% or more of the time during 800-m plot/20-min surveys (Table 3).

Table 3. Flight height characteristics by large bird type and raptor subtype within 800 meters and in the first 20 minutes of the large birdsurveys at the Emerson Creek Wind Project from September 16, 2016 – December 18, 2017.

Bird Type	# Groups Flying	# Ind. Flying	Estimated Mean Flight Height (m)	% Obs Flying	% Estimated within Flight Height Categories		
					0-25 m	25-200 m[a]	> 200 m
Waterbirds	5	5	51	83.3	40.0	60	0
Waterfowl	19	68	58	87.2	27.9	72.1	0
Shorebirds	21	32	43	82.1	37.5	62.5	0
Gulls/Terns	4	69	83	100	0	100	0
Diurnal Raptors	**55**	**64**	**122**	**71.9**	**21.9**	**64.1**	**14.1**
Accipiters	4	4	200	100	0	50	50
Buteos	28	36	114	76.6	8.3	83.3	8.3
Northern Harrier	8	8	26	100	75.0	25	0
Eagles	9	9	258	100	0	55.6	44.4
Falcons	6	7	29	33.3	71.4	28.6	0
Vultures	113	284	84	94.4	6.0	90.5	3.5
Doves/Pigeons	22	76	19	90.5	39.5	60.5	0
Large Corvids	46	88	28	71.5	56.8	43.2	0
Large Birds Overall	**285**	**686**	**72**	**86.9**	**21.0**	**76.2**	**2.8**

[a] The likely “rotor-swept height” for potential collision with a turbine blade above ground level.

Ind = individuals; m = meters; Obs = observed

Values may not add up due to rounding.

Raptor Migration

The spring and fall seasons defined in this analysis are comparable to those outlined in the ODNR Protocol for raptor migration surveys (e.g., spring [March 15 to May 1] and fall [September 1 to October 31]). Raptor migration during the spring and fall does not appear to be concentrated within the Project as diurnal raptor use was similar among three seasons and lowest during the spring (Table 2). Three raptor species (red-tailed hawk, northern harrier, and American kestrel [*Falco sparverius*]), were observed during all the seasons at the Project. Red-tailed hawk and American kestrel are considered common raptor species of the Midwest (Pardieck et al. 2017). Bald eagles were observed during most seasons, with the exception of spring. Accipiters were rarely observed at the Project; Cooper’s hawk (*Accipiter cooperii*) was observed in the spring, summer and fall in low numbers (one or two individuals for each season; Appendix A). Overall, concentrations of raptors were not observed during surveys with respect to spatial or temporal patterns.

Eagles

A total of 17 bald eagle observations in 17 groups were recorded within 800 m (2,625 ft) of survey locations during 252 hours of ECPG-level surveys over the course of the 15 month study (Tables 4a and 4b). No golden eagles were observed during the surveys. Bald eagles were observed at nine of the 21 survey points. Seven of the 17 observations were recorded at Point 41, which is located 0.7 mi southeast from a known eagle nest that was active in 2017. The remainder of the observations were scattered throughout the Project at relatively low levels (Figure 3). Overall mean use was 0.07 eagles/800-m survey/60-min survey across the entire study period, and the total number of risk minutes documented was 17. Seasonal mean use varied from no use in the spring to 0.12 in the summer and fall. A total of 50% of all eagle observations recorded in flight were within the RSH. Eagle flight paths are presented in Figure 4.

Table 4a. Number of eagle observations and estimated risk minutes within 800 meters of the observer and below 200 meters flight height during eagle use surveys at Emerson Creek Wind Project from September 16, 2016 – December 18, 2017.

Season	Eagle Observations	Estimated Eagle Risk Minutes	Survey Effort (hours)	Eagle Observations/Hour
Spring	0	0	63	0
Summer	8	4	67	0.12
Fall	5	9	42	0.12
Winter	4	4	80	0.05
Total	**17**	**17**	**252**	**0.07**

Table 4b. Number of bald eagle observations and estimated risk minutes within 800 meters of the observer and below 200 meters flight height during eagle use surveys at Emerson Creek Wind Project from September 16, 2016 – December 18, 2017.

Survey Location	Bald Eagle Observations within 800 m	Estimated Bald Eagle Risk Minutes	Survey Effort (hours)	Bald Eagle Observations within 800 m/Hour	Bald Eagle Risk Minutes/Hour
21	1	4	12	0.08	0.33
23	0	0	12	0.00	0.00
24	0	0	12	0.00	0.00
25	1	3	12	0.08	0.25
26	0	0	12	0.00	0.00
27	0	0	12	0.00	0.00
28	0	0	12	0.00	0.00
29	1	0	12	0.08	0.00
30	2	3	12	0.17	0.25
31	2	0	12	0.17	0.00
32	0	0	12	0.00	0.00
33	0	0	12	0.00	0.00
34	1	0	12	0.08	0.00
35	0	0	12	0.00	0.00
36	1	0	12	0.08	0.00
37	0	0	12	0.00	0.00

38	0	0	12	0.00	0.00
39	0	0	12	0.00	0.00
41	7	5	12	0.58	0.42
42	1	2	12	0.08	0.17
43	0	0	12	0.00	0.00
Total	**17**	**17**	**252**	**0.07**	0.07

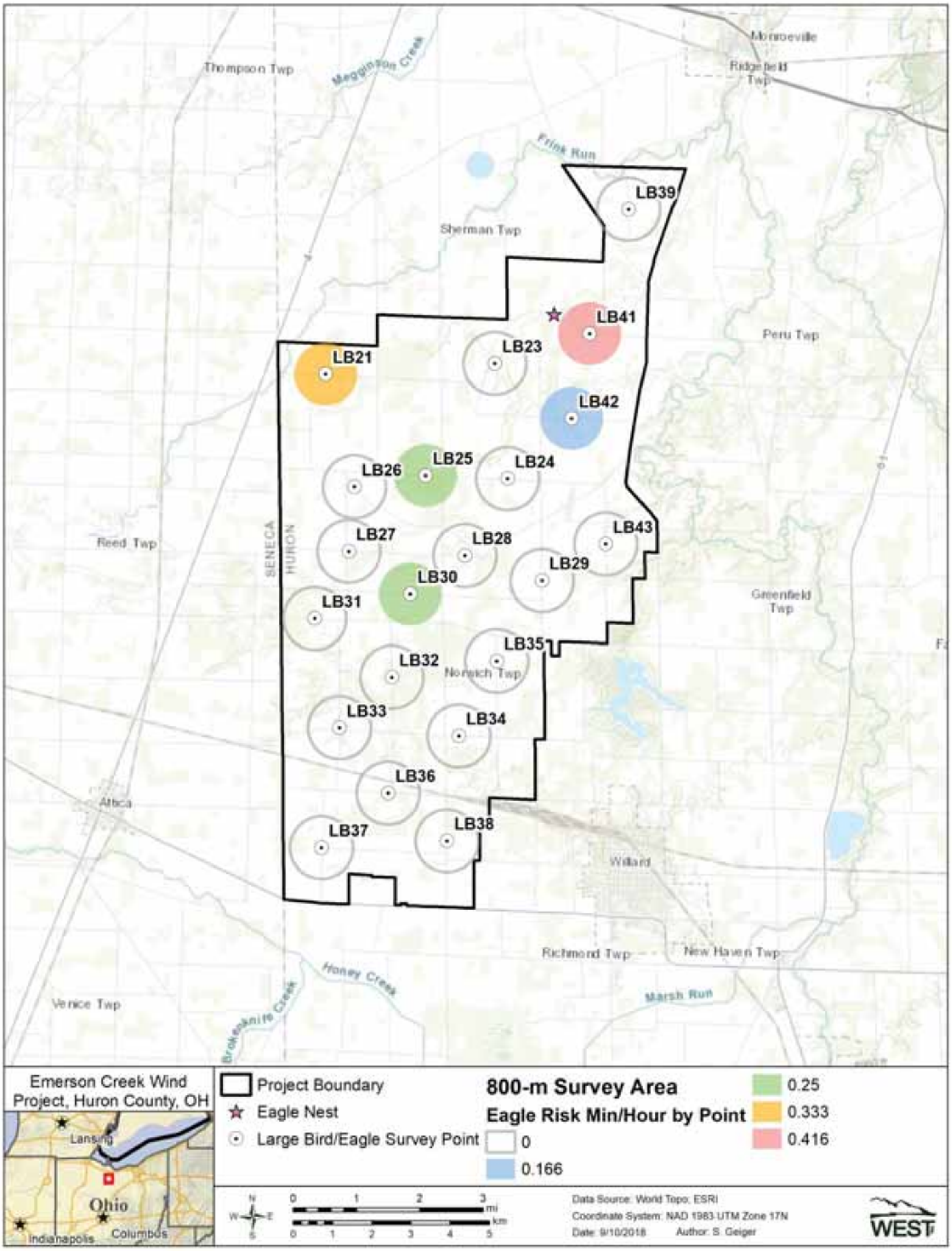

Figure 3. Bald eagle risk minutes within 800 meters and flying below 200 m per hour by observation point during eagle use surveys completed at Emerson Creek Wind Project from September 16, 2016 – December 18, 2017.

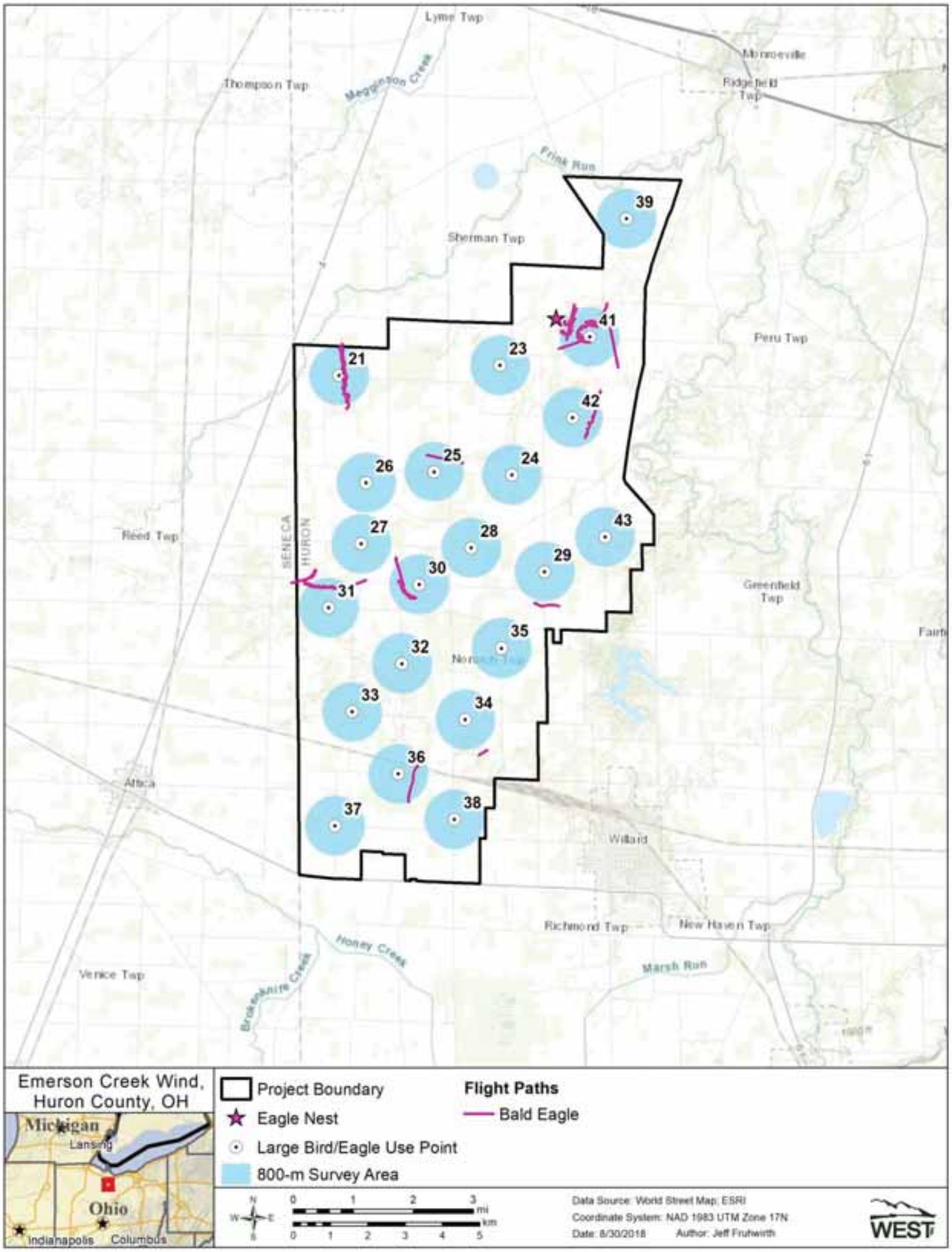

Figure 4. Locations of eagle nests and estimated flight paths of eagles recorded during large bird and eagle use surveys at the Emerson Creek Wind Project from September 16, 2016 – December 18, 2017.

Special Status Species

No federally-listed threatened or endangered species were recorded during the surveys or incidentally (USFWS 2017). One state-listed species was recorded: the state-endangered northern harrier (n=13). Northern harriers were recorded during all seasons, but were most commonly observed during the winter and spring. In addition, one BCC species was recorded (red-headed woodpecker [*Melanerpes erythrocephalus*]; n=1).

DISCUSSION

Large Birds

Large bird species most often observed in the 20-min surveys included turkey vulture, American crow, and mourning dove (Appendix A). These large bird species observed are common, geographically abundant, and species whose populations are likely to be unaffected by any potential habitat fragmentation or collision related to the Project. Thus impacts to large bird populations from the Project during all seasons are unlikely to be significant.

Diurnal Raptors

Estimates of potential mean raptor use are often made to assess potential impacts by comparing them with other wind-energy projects' fatality estimates. WEST compared the mean raptor use of the Project with 46 other publicly available wind energy facilities that implemented similar protocols and had data recorded for three or four seasons. The annual mean raptor use at these 46 wind energy facilities ranged from 0.06 to 2.34 raptors/800-m plot/20-min survey (Appendix D). Within the Midwest, diurnal raptor fatality rates have ranged from zero to 0.59 raptors/megawatt (MW)/year, with a mean of 0.07 raptors/MW/year (Appendix E).

A relative ranking of annual mean raptor use was developed based on the results from these 46 wind energy facilities as low (0 – 0.5 raptors/800-m plot/20-min survey), low to moderate (0.5 – 1.0 raptors/800-m plot/20-min survey), moderate (1.0 – 2.0 raptors/800-m plot/20-min survey), high (2.0 – 3.0 raptors/800-m plot/20-min survey), and very high (more than 3.0 raptors/800-m plot/20-min survey). Under this ranking, annual mean diurnal raptor use at the Project (0.33 - 0.41 raptors/800-m plot/20-min survey) is low. In addition, raptor use was relatively similar across all seasons (the lowest use being in spring) and therefore the Project did not experience high raptor use during migration.

Eagles

Bald eagles were recorded using the Project during most of the seasons, with the exception of spring. Bald eagle activity was concentrated near Point 41, which is located approximately 0.7 mi southeast of an active bald eagle nest. There are no other landscape features within the Project that appear to concentrate eagle use. Avoiding siting turbines near this nest and point 41 may be appropriate to minimize risk.

Golden eagles are rare in the Midwest and eastern US, as they are most commonly found west of Texas and nest in Alaska and Canada. No golden eagles were observed within the Project during the 252 hours of avian use surveys or incidentally. The risk of mortality to golden eagles is considered low and unlikely to occur.

Special Status Species

No federally listed endangered or threatened species were observed during surveys, suggesting low risk to these species at the Project. One federal BCC species, the red-headed woodpecker, was observed during surveys. There is only one documented red-headed woodpecker fatality from an operating wind farm in the Midwest (see Appendix F for a list of facilities and references). The single individual observed, coupled with the single documented fatality, lead to a very low risk situation for this species.

Northern harriers were observed within the Project and are also commonly observed during avian use surveys at wind energy facilities, yet no fatalities of this species have been recorded in the Midwest (See Appendix F for a list of facilities and references). The lack of fatalities is likely due to the northern harrier's hunting and flight habits. Northern harriers generally hunt and fly at low elevations, and therefore, have a low risk of collision with modern wind turbines (Whitfield and Madders 2005). The majority of northern harriers were observed flying below the RSH during the large bird use surveys. Northern harriers were more commonly observed in the winter, but use by one individual was recorded during the summer. Northern harrier breeding habitat is rare within the Project, with only 1.4% of the Project classified as hayfields/pasture or herbaceous, and there are no grasslands according to NLCD data (USGS NLCD 2011, Homer et al. 2015).

CONCLUSIONS

Analysis of the data collected during the surveys generally indicates that development of the Project is not likely to cause significant impacts to large bird populations, including diurnal raptors or special status species. The majority of species observed are widespread and abundant, suggesting low risk of adverse impacts to large bird populations. The one BCC observed (red-headed woodpecker) occurred in very low numbers, and has rarely been documented in post-construction fatality studies in the Midwest. The majority (75.0%) of the northern harrier observations were recorded below the RSH, nesting habitat is limited, and the species has not been documented in post-construction fatality studies in the Midwest; therefore, the project poses minimal risk to these special status species.

Bald eagles were recorded using the Project during all seasons, and use during surveys was concentrated near a known eagle nest. The presence of an active bald eagle nest within the Project may warrant management consideration, such as avoiding siting turbines in close proximity to the nest to reduce potential collision risk. No other landscape features within the Project appear to concentrate eagles.

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Appendix A. Species Observed at the Emerson Creek Wind Project from September 16, 2016 – December 18, 2017

Appendix A. Summary of individuals (obs) and group (grps) observations within 800 meters by bird type and species for 20-minute large bird surveys at the Emerson Creek Wind Project from September 16, 2016 – December 18, 2017.

		Spring		Summer		Fall		Winter		Total	
Type/Species	**Scientific name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Waterbirds		**1**	**1**	**4**	**4**	**0**	**0**	**1**	**1**	**6**	**6**
great blue heron	*Ardea herodias*	1	1	4	4	0	0	1	1	6	6
Waterfowl		**10**	**27**	**1**	**3**	**0**	**0**	**12**	**48**	**23**	**78**
Canada goose	*Branta canadensis*	7	15	1	3	0	0	12	48	20	66
mallard	*Anas platyrhynchos*	1	1	0	0	0	0	0	0	1	1
wood duck	*Aix sponsa*	2	11	0	0	0	0	0	0	2	11
Shorebirds		**11**	**13**	**5**	**10**	**3**	**5**	**7**	**11**	**26**	**39**
killdeer	*Charadrius vociferus*	11	13	5	10	3	5	7	11	26	39
Gulls/Terns		**2**	**23**	**0**	**0**	**0**	**0**	**2**	**46**	**4**	**69**
herring gull	*Larus argentatus*	0	0	0	0	0	0	1	45	1	45
ring-billed gull	*Larus delawarensis*	2	23	0	0	0	0	1	1	3	24
Diurnal Raptors		**17**	**19**	**20**	**25**	**14**	**14**	**27**	**33**	**78**	**91**
Accipiters		*2*	*2*	*1*	*1*	*1*	*1*	*0*	*0*	*4*	*4*
Cooper's hawk	*Accipiter cooperii*	2	2	1	1	1	1	0	0	4	4
Buteos		*9*	*10*	*7*	*8*	*6*	*6*	*17*	*23*	*39*	*47*
red-tailed hawk	*Buteo jamaicensis*	9	10	7	8	6	6	17	23	39	47
Northern Harrier		*2*	*2*	*1*	*1*	*1*	*1*	*4*	*4*	*8*	*8*
northern harrier	*Circus cyaneus*	2	2	1	1	1	1	4	4	8	8
Eagles		*0*	*0*	*5*	*5*	*4*	*4*	*2*	*2*	*11*	*11*
bald eagle	*Haliaeetus leucocephalus*	0	0	5	5	4	4	2	2	11	11
Falcons		*4*	*5*	*6*	*10*	*2*	*2*	*4*	*4*	*16*	*21*
American kestrel	*Falco sparverius*	4	5	6	10	2	2	4	4	16	21
Vultures		**56**	**128**	**36**	**78**	**26**	**94**	**1**	**2**	**119**	**302**
turkey vulture	*Cathartes aura*	56	128	36	78	26	94	1	2	119	302
Doves/Pigeons		**10**	**14**	**5**	**45**	**6**	**8**	**7**	**17**	**28**	**84**
mourning dove	*Zenaida macroura*	8	11	5	45	5	6	5	15	23	77
rock pigeon	*Columba livia*	2	3	0	0	1	2	2	2	5	7
Large Corvids		**10**	**20**	**10**	**24**	**5**	**8**	**34**	**71**	**59**	**123**
American crow	*Corvus brachyrhynchos*	10	20	10	24	5	8	34	71	59	123
Woodpeckers		**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**1**	**1**
red-headed woodpecker	*Melanerpes erythrocephalus*	0	0	0	0	1	1	0	0	1	1
Overall		**117**	**245**	**81**	**189**	**55**	**130**	**91**	**229**	**344**	**793**

Appendix B. Mean Use, Percent of Use, and Frequency of Occurrence for Large Birds Observed during Large Bird Surveys at the Emerson Creek Wind Project from September 16, 2016 – December 18, 2017

Appendix B. Mean large bird use (number of large birds/800-meter plot/20-minute survey), percent of total use, and frequency of occurrence (%) for each large bird type and species by season during large bird survey at the Emerson Creek Wind Project from September 16, 2016 – December 18, 2017.

	Mean Use				% of Use				% Frequency			
Type/Species	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Waterbirds	**0.02**	**0.05**	**0**	**0.05**	**0.4**	**1.3**	**0**	**1.6**	**1.6**	**4.9**	**0**	**5.0**
great blue heron	0.02	0.05	0	0.05	0.4	1.3	0	1.6	1.6	4.9	0	5.0
Waterfowl	**0.43**	**0.12**	**0**	**0.78**	**11.0**	**3.2**	**0**	**25.2**	**12.7**	**4.2**	**0**	**13.6**
Canada goose	0.24	0.12	0	0.78	6.1	3.2	0	25.2	9.5	4.2	0	13.6
mallard	0.02	0	0	0	0.4	0	0	0	1.6	0	0	0
wood duck	0.17	0	0	0	4.5	0	0	0	3.2	0	0	0
Shorebirds	**0.21**	**0.21**	**0.07**	**0.10**	**5.3**	**5.4**	**3.2**	**3.4**	**17.5**	**9.1**	**4.4**	**5.7**
killdeer	0.21	0.21	0.07	0.10	5.3	5.4	3.2	3.4	17.5	9.1	4.4	5.7
Gulls/Terns	**0.37**	**0**	**0**	**0.54**	**9.4**	**0**	**0**	**17.4**	**3.2**	**0**	**0**	**2.1**
Herring gull	0	0	0	0.53	0	0	0	17.1	0	0	0	1.2
ring-billed gull	0.37	0	0	<0.01	9.4	0	0	0.3	3.2	0	0	1
Diurnal Raptors	**0.30**	**0.41**	**0.49**	**0.36**	**7.9**	**10.6**	**21.6**	**12.0**	**22.2**	**23.2**	**33.8**	**27.0**
Accipiters	*0.03*	*0.01*	*0.01*	*0*	*0.8*	*0.3*	*0.6*	*0*	*3.2*	*1.2*	*1.5*	*0*
Cooper's hawk	0.03	0.01	0.01	0	0.8	0.3	0.6	0	3.2	1.2	1.5	0
Buteos	*0.16*	*0.16*	*0.28*	*0.28*	*4.1*	*4.0*	*12.3*	*9.0*	*14.3*	*14.5*	*27.9*	*19.7*
red-tailed hawk	0.16	0.16	0.28	0.28	4.1	4.0	12.3	9.0	14.3	14.5	27.9	19.7
Northern Harrier	*0.03*	*0.01*	*0.01*	*0.04*	*0.8*	*0.3*	*0.6*	*1.4*	*3.2*	*1.2*	*1.5*	*4.5*
northern harrier	0.03	0.01	0.01	0.04	0.8	0.3	0.6	1.4	3.2	1.2	1.5	4.5
Eagles	*0*	*0.05*	*0.11*	*<0.01*	*0*	*1.3*	*4.7*	*0.3*	*0*	*2.5*	*9.2*	*1.0*
bald eagle	0	0.05	0.11	<0.01	0	1.3	4.7	0.3	0	2.5	9.2	1.0
Falcons	*0.08*	*0.18*	*0.08*	*0.04*	*2*	*4.7*	*3.4*	*1.3*	*4.8*	*10.5*	*7.7*	*4.0*
American kestrel	0.08	0.18	0.08	0.04	2	4.7	3.4	1.3	4.8	10.5	7.7	4.0
Vultures	**2.03**	**1**	**1.37**	**0.02**	**52.2**	**25.6**	**60.4**	**0.6**	**58.7**	**35.1**	**26.5**	**1.0**
turkey vulture	2.03	1	1.37	0.02	52.2	25.6	60.4	0.6	58.7	35.1	26.5	1.0
Doves/Pigeons	**0.22**	**1.73**	**0.12**	**0.16**	**5.7**	**44.2**	**5.2**	**5.2**	**14.3**	**8.9**	**8.8**	**5.7**
mourning dove	0.17	1.73	0.09	0.14	4.5	44.2	3.9	4.6	12.7	8.9	7.4	3.8
rock pigeon	0.05	0	0.03	0.02	1.2	0	1.3	0.6	3.2	0	1.5	1.9
Large Corvids	**0.32**	**0.38**	**0.21**	**1.07**	**8.2**	**9.7**	**9.4**	**34.6**	**14.3**	**15.1**	**16.9**	**38.2**
American crow	0.32	0.38	0.21	1.07	8.2	9.7	9.4	34.6	14.3	15.1	16.9	38.2
Overall	**3.89**	**3.91**	**2.26**	**3.10**	**100**	**100**	**100**	**100**				

Appendix C. Overall Mean Use by Point for All Large Birds and Major Large Bird Types during Large Bird Use Surveys at the Emerson Creek Wind Project from September 16, 2016 – December 18, 2017

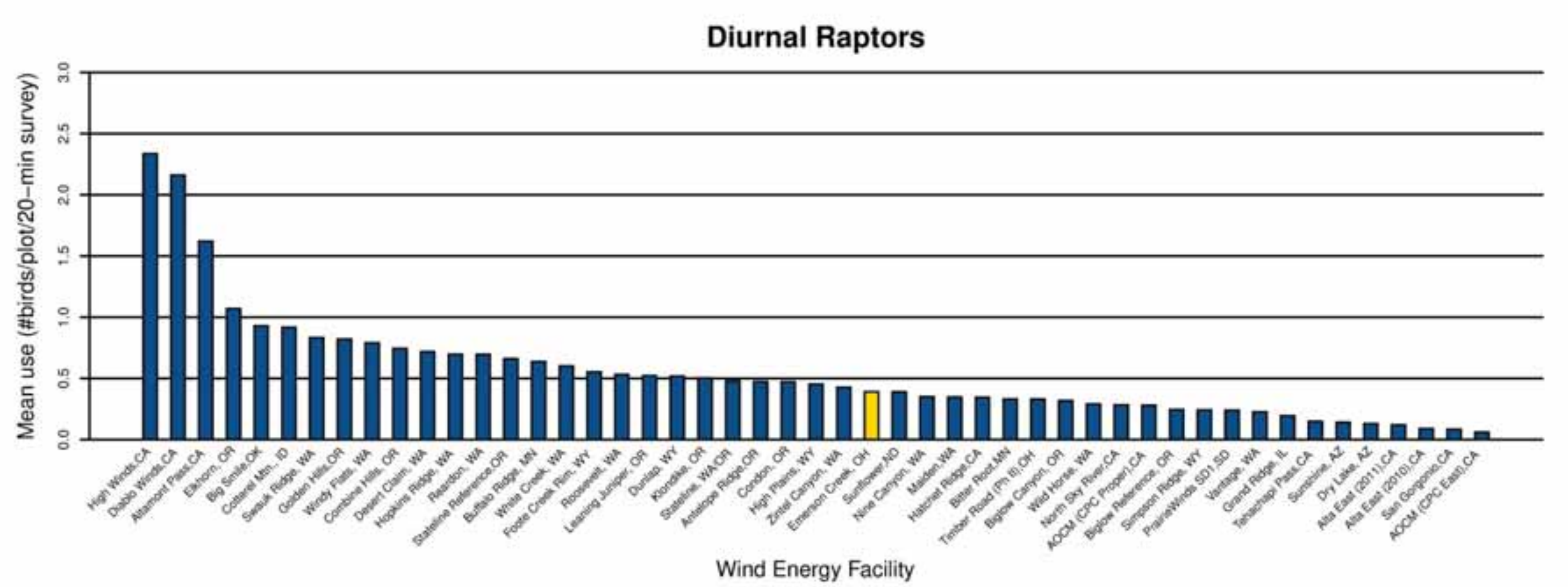
Appendix C. Mean use for large birds (number of birds/800-meter plot/20-minute survey) by point for all major large bird types observed at the Emerson Creek Wind Project from September 16, 2016 – December 18, 2017.

	Survey Point										
Bird Type	**21**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
Waterbirds	0	0.08	0	0	0	0	0	0	0	0	0
Waterfowl	0	0.25	0	0	0.08	0	0.08	0	0	0.83	1.00
Shorebirds	0.25	0.33	0	0.50	0	0.17	0	0	0.08	0.42	0.08
Gulls/Terns	0	0	0.08	0	0	0	0	0	0	0	0
Diurnal Raptors	0.08	0.33	0.16	0.16	0.42	0.08	0.75	0.33	0.5	0.41	0.33
Accipiters	*0*	*0.08*	*0*	*0*	*0*	*0*	*0*	*0.08*	*0*	*0*	*0*
Buteos	*0.08*	*0*	*0.08*	*0.08*	*0.17*	*0.08*	*0.75*	*0.17*	*0.08*	*0.17*	*0.33*
Northern Harrier	*0*	*0.17*	*0*	*0*	*0.17*	*0*	*0*	*0.08*	*0*	*0.08*	*0*
Eagles	*0*	*0*	*0*	*0.08*	*0*	*0*	*0*	*0*	*0.17*	*0.08*	*0*
Falcons	*0*	*0.08*	*0.08*	*0*	*0.08*	*0*	*0*	*0*	*0.25*	*0.08*	*0*
Vultures	0.50	0.08	0.5	0.75	0.25	1.58	2.00	1.58	0	1.08	1.83
Doves/Pigeons	0	3.75	0.25	0.50	0.25	0	0	0.42	0.25	0.17	0.08
Large Corvids	0	0.25	0.58	0.33	0.58	1.00	0.50	2.08	0.42	0.25	0.67
All Large Birds	**0.83**	**5.08**	**1.58**	**2.25**	**1.58**	**2.83**	**3.33**	**4.42**	**1.25**	**3.17**	**4.00**

Appendix C (*continued*). Mean use for large birds (number of birds/800-meter plot/20-minute survey) by point for all major large bird types observed at the Emerson Creek Wind Project from September 16, 2016 – December 18, 2017.

	Survey Point									
Bird Type	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**41**	**42**	**43**
Waterbirds	0	0.08	0	0	0.08	0	0	0.08	0.17	0
Waterfowl	0.25	0.50	0.17	0	0.17	0.17	0.08	0	2.92	0
Shorebirds	0.08	0	0	0	0	0.50	0.17	0.42	0.08	0.17
Gulls/Terns	0	0	0	3.75	0	0	0	1.83	0.08	0
Diurnal Raptors	0.33	0.17	0.42	0.67	0.25	0	0.75	0.83	0.33	0.08
Accipiters	*0*	*0*	*0*	*0.08*	*0*	*0*	*0.08*	*0*	*0*	*0*
Buteos	*0.08*	*0.17*	*0.25*	*0.33*	*0.08*	*0*	*0.33*	*0.33*	*0.25*	*0.08*
Northern Harrier	*0*	*0*	*0.17*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Eagles	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0.33*	*0.08*	*0*
Falcons	*0.25*	*0*	*0*	*0.25*	*0.17*	*0*	*0.33*	*0.17*	*0*	*0*
Vultures	2.58	0.67	1.75	1.08	2.67	1.67	0.08	2.58	1.33	0.5
Doves/Pigeons	0.25	0	0	0.08	0.08	0	0.92	0	0	0
Large Corvids	0	0.08	0.33	0	0.42	0.17	0.83	0.25	0.58	0.92
All Large Birds	**3.50**	**1.50**	**2.67**	**5.58**	**3.67**	**2.50**	**2.83**	**6.00**	**5.50**	**1.67**

Appendix D. Comparison of Diurnal Raptor Use at North American Wind Energy Facilities



Appendix D. Comparison of annual diurnal raptor use during large bird and eagle use surveys at the Emerson Creek Wind Project from September 16, 2016 – December 18, 2017, and annual diurnal raptor use recorded at other North American wind energy facilities.

Data from the following sources:

Study and Location	Reference	Study and Location	Reference	Study and Location	Reference
Emerson Creek, OH	**This study.**				
High Winds, CA	Kerlinger et al. 2005	Foote Creek Rim, WY	Johnson et al. 2000b	Wild Horse, WA	Erickson et al. 2003d
Diablo Winds, CA	WEST 2006	Roosevelt, WA	NWC and WEST 2004	North Sky River, CA	Erickson et al. 2011
Altamont Pass, CA	Orloff and Flannery 1992	Leaning Juniper, OR	Kronner et al. 2005	AOCM (CPC Proper), CA	Chatfield et al. 2010
Elkhorn, OR	WEST 2005a	Dunlap, WY	Johnson et al. 2009a	Biglow Reference, OR	WEST 2005c
Big Smile (Dempsey), OK	Derby et al. 2010b	Klondike, OR	Johnson et al. 2002	Simpson Ridge, WY	Johnson et al. 2000b
Cotterel Mtn., ID	BLM 2006	Stateline, WA/OR	Erickson et al. 2003b	Vantage, WA	Jeffrey et al. 2007
Swauk Ridge, WA	Erickson et al. 2003c	Antelope Ridge, OR	WEST 2009	Grand Ridge, IL	Derby et al. 2009
Golden Hills, OR	Jeffrey et al. 2008	Condon, OR	Erickson et al. 2002b	Tehachapi Pass, CA	Anderson et al. 2000, Erickson et al. 2002b
Windy Flats, WA	Johnson et al. 2007	High Plains, WY	Johnson et al. 2009b	Sunshine, AZ	WEST and the CPRS 2006
Combine Hills, OR	Young et al. 2003a	Zintel Canyon, WA	Erickson et al. 2002a, 2003a	Dry Lake, AZ	Young et al. 2007b
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. 2007a	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		

Appendix E. Midwest Raptor Fatality Summary Table

Appendix E. Wind energy facilities in the Midwest region of North America with comparable use and fatality data for diurnal raptors.

Project Name	Use Estimate[A]	Raptor Fatality Estimate[B]	No. of Turbines	Total MW
Emerson Creek, OH (2016-2017)	**0.39**			
		Midwest		
Buffalo Ridge, MN (Phase I; 1999)	NA	0.47	73	25
Moraine II, MN (2009)	NA	0.37	33	49.5
Winnebago, IA (2009-2010)	NA	0.27	10	20
Buffalo Ridge I, SD (2009-2010)	NA	0.2	24	50.4
Cedar Ridge, WI (2009)	NA	0.18	41	67.6
PrairieWinds SD1, SD (2013-2014)	NA	0.17	108	162
Top of Iowa, IA (2004)	NA	0.17	89	80
Cedar Ridge, WI (2010)	NA	0.13	41	68
Ripley, Ont (2008)	NA	0.1	38	76
Wessington Springs, SD (2010)	0.232	0.07	34	51
Rugby, ND (2010-2011)	NA	0.06	71	149
NPPD Ainsworth, NE (2006)	NA	0.06	36	20.5
Wessington Springs, SD (2009)	0.232	0.06	34	51
PrairieWinds ND1 (Minot), ND (2011)	NA	0.05	80	115.5
PrairieWinds ND1 (Minot), ND (2010)	NA	0.05	80	115.5
PrairieWinds SD1, SD (2012-2013)	NA	0.03	108	162
Elm Creek, MN (2009-2010)	NA	0	67	100
Rail Splitter, IL (2012-2013)	NA	0	67	100.5
Pioneer Prairie II, IA (2011-2012)	NA	0	62	102.3
Buffalo Ridge, MN (Phase III; 1999)	NA	0	138	103.5
Buffalo Ridge, MN (Phase II; 1998)	NA	0	143	107.25
Buffalo Ridge, MN (Phase II; 1999)	NA	0	143	107.25
Blue Sky Green Field, WI (2008; 2009)	NA	0	88	145
Elm Creek II, MN (2011-2012)	NA	0	62	148.8
Barton I & II, IA (2010-2011)	NA	0	80	160
PrairieWinds SD1, SD (2011-2012)	NA	0	108	162
Kewaunee County, WI (1999-2001)	NA	0	31	20.46
Buffalo Ridge II, SD (2011-2012)	NA	0	105	210
Buffalo Ridge, MN (Phase I; 1996)	NA	0	73	25
Buffalo Ridge, MN (Phase I; 1997)	NA	0	73	25
Buffalo Ridge, MN (Phase I; 1998)	NA	0	73	25
Fowler I, IN (2009)	NA	0	162	301
Big Blue, MN (2013)	NA	0	18	36
Big Blue, MN (2014)	NA	0	18	36
Top of Iowa, IA (2003)	NA	0	89	80
Grand Ridge I, IL (2009-2010)	0.195	0	66	99

A=number of raptors/plot/20min survey
B=number of fatalities/MW/year

MW = megawatts; NA = not available

Appendix E (*continued*). Wind energy facilities in the Midwest region of North America with comparable use and fatality data for diurnal raptors. Data from the following sources:

Project Name	Use Reference	Fatality Reference	Project Name	Use Reference	Fatality Reference
Emerson Creek, OH (16-17)	This study				
Barton I & II, IA (2010-2011)	NA	Derby et al. 2011b	Grand Ridge I, IL (2009-2010)	Derby et al. 2009	Derby et al. 2010a
Big Blue, MN (2013)	NA	Fagen Engineering 2014	Kewaunee County, WI (1999-2001)	NA	Howe et al. 2002
Big Blue, MN (2014)	NA	Fagen Engineering 2015	Moraine II, MN (2009)	NA	Derby et al. 2010g
Blue Sky Green Field, WI (2008; 2009)	NA	Gruver et al. 2009	NPPD Ainsworth, NE (2006)	NA	Derby et al. 2007
Buffalo Ridge, MN (Phase I; 1996)	NA	Johnson et al. 2000a	Pioneer Prairie II, IA (2011-2012)	NA	Chodachek et al. 2012
Buffalo Ridge, MN (Phase I; 1997)	NA	Johnson et al. 2000a	PrairieWinds ND1 (Minot), ND (2010)	NA	Derby et al. 2011d
Buffalo Ridge, MN (Phase I; 1998)	NA	Johnson et al. 2000a	PrairieWinds ND1 (Minot), ND (2011)	NA	Derby et al. 2012c
Buffalo Ridge, MN (Phase I; 1999)	NA	Johnson et al. 2000a	PrairieWinds SD1, SD (2011-2012)	NA	Derby et al. 2012d
Buffalo Ridge, MN (Phase II; 1998)	NA	Johnson et al. 2000a	PrairieWinds SD1, SD (2012-2013)	NA	Derby et al. 2013
Buffalo Ridge, MN (Phase II; 1999)	NA	Johnson et al. 2000a	PrairieWinds SD1, SD (2013-2014)	NA	Derby et al. 2014
Buffalo Ridge, MN (Phase III; 1999)	NA	Johnson et al. 2000a	Rail Splitter, IL (2012-2013)	NA	Good et al. 2013a
Buffalo Ridge I, SD (2009-2010)	NA	Derby et al. 2010e	Ripley, Ont (2008)	NA	Jacques Whitford 2009
Buffalo Ridge II, SD (2011-2012)	NA	Derby et al. 2012a	Rugby, ND (2010-2011)	NA	Derby et al. 2011c
Cedar Ridge, WI (2009)	NA	BHE Environmental 2010	Top of Iowa, IA (2003)	NA	Jain 2005
Cedar Ridge, WI (2010)	NA	BHE Environmental 2011	Top of Iowa, IA (2004)	NA	Jain 2005
Elm Creek, MN (2009-2010)	NA	Derby et al. 2010f	Wessington Springs, SD (2009)	Derby et al. 2008	Derby et al. 2010d
Elm Creek II, MN (2011-2012)	NA	Derby et al. 2012b	Wessington Springs, SD (2010)	NA	Derby et al. 2011a
Fowler I, IN (2009)	NA	Johnson et al. 2010	Winnebago, IA (2009-2010)	NA	Derby et al. 2010h

Appendix F. Summary of Publicly Available Studies at Midwestern Wind Energy Facilities That Report Bird Fatalities

Appendix F. Summary of publicly available studies at Midwestern wind energy facilities that report bird fatalities.

Project Name	Reference	Project	Reference
Barton I & II, IA (10-11)	Derby et al. 2011b	Fowler III, IN (09)	Johnson et al. 2010b
Big Blue, MN (13)	Fagen Engineering 2014	Grand Ridge I, IL (09-10)	Derby et al. 2010a
Big Blue, MN (14)	Fagen Engineering 2015	Harrow, Ont (10)	Natural Resources Solutions Inc. (NRSI) 2011
Blue Sky Green Field, WI (08; 09)	Gruver et al. 2009	Heritage Garden I, MI (12-14)	Kerlinger et al. 2014
Buffalo Ridge, MN (94-95)	Osborn et al. 1996, Osborn et al. 2000	Heritage Garden I, MI (12-14)	Kerlinger et al. 2014
Buffalo Ridge, MN (00)	Krenz and McMillan	Kewaunee County, WI (99-01)	Howe et al. 2002
Buffalo Ridge, MN (Phase I; 96)	Johnson et al. 2000	Lakefield Wind, MN (12)	Minnesota Public Utilities Commission (MPUC). 2012
Buffalo Ridge, MN (Phase I; 97)	Johnson et al. 2000	Melancthon, Ont (Phase I; 07)	Stantec Ltd. 2008
Buffalo Ridge, MN (Phase I; 98)	Johnson et al. 2000	Moraine II, MN (09)	Derby et al. 2010g
Buffalo Ridge, MN (Phase I; 99)	Johnson et al. 2000	NPPD Ainsworth, NE (06)	Derby et al. 2007
Buffalo Ridge, MN (Phase II; 98)	Johnson et al. 2000	Pioneer Prairie II, IA (11-12)	Chodachek et al. 2012
Buffalo Ridge, MN (Phase II; 99)	Johnson et al. 2000	Pioneer Prairie II, IA (13)	Chodachek et al. 2014
Buffalo Ridge, MN (Phase II; 01/Lake Benton I)	Johnson et al. 2004	Pioneer Trail, IL (12-13)	ARCADIS U.S., Inc. 2013
Buffalo Ridge, MN (Phase II; 02/Lake Benton I)	Johnson et al. 2004	Prairie Rose, MN (14)	Chodachek et al. 2015
Buffalo Ridge, MN (Phase III; 99)	Johnson et al. 2000	PrairieWinds SD1, SD (12-13)	Derby et al. 2013
Buffalo Ridge, MN (Phase III; 01/Lake Benton II)	Johnson et al. 2004	PrairieWinds SD1, SD (13-14)	Derby et al. 2014
Buffalo Ridge, MN (Phase III; 02/Lake Benton II)	Johnson et al. 2004	PrairieWinds ND1 (Minot), ND (10)	Derby et al. 2011d
Buffalo Ridge I, SD (09-10)	Derby et al. 2010e	PrairieWinds ND1 (Minot), ND (11)	Derby et al. 2012c
Buffalo Ridge II, SD (11-12)	Derby et al. 2012	PrairieWinds SD1, SD (11-12)	Derby et al. 2012d
Cedar Ridge, WI (09)	BHE Environmental 2010	Rail Splitter, IL (12-13)	Good et al. 2013b
Cedar Ridge, WI (10)	BHE Environmental 2011	Ripley, Ont (08)	Jacques Whitford 2009
Crescent Ridge, IL (05-06)	Kerlinger et al. 2007	Ripley, Ont (08-09)	Golder Associates 2010
Crystal Lake II, IA (09)	Derby et al. 2010c	Rugby, ND (10-11)	Derby et al. 2011c
Elm Creek, MN (09-10)	Derby et al. 2010f	Top Crop I & II (12-13)	Good et al. 2013b
Elm Creek II, MN (11-12)	Derby et al. 2012	Top of Iowa, IA (03)	Jain 2005
Forward Energy Center, WI (08-10)	Grodsky and Drake 2011	Top of Iowa, IA (04)	Jain 2005
Fowler I, IN (09)	Johnson et al. 2010a	Wessington Springs, SD (09)	Derby et al. 2010d
Fowler I, II, III, IN (10)	Good et al. 2011	Wessington Springs, SD (10)	Derby et al. 2011a
Fowler I, II, III, IN (11)	Good et al. 2012	Winnebago, IA (09-10)	Derby et al. 2010h

Exhibit S
Raptor Migration/Use Surveys

3. Wildlife Baseline Studies for the Emerson Creek Wind Resource Area Seneca and Huron Counties, Ohio dated February 6, 2013

Christine M.T. Pirik (0029759)
(Counsel of Record)
Terrence O'Donnell (0074213)
William V. Vorys (0093479)
Dickinson Wright PLLC
150 East Gay Street, Suite 2400
Columbus, Ohio 43215
Phone: (614) 591-5461
Email: cpirik@dickinsonwright.com
todonnell@dickinsonwright.com
wvorys@dickinsonwright.com

Attorneys for Firelands Wind, LLC

Wildlife Baseline Studies for the Emerson Creek Wind Resource Area Seneca and Huron Counties, Ohio

Final Report
September 2010 – August 2011

Apex Wind Energy, Inc.

Queen Charlotte Building
212 East High Street
Charlottesville, VA 22902

Prepared by:

Michelle L. Ritzert, Jason P. Ritzert, and Rhett Good

Western EcoSystems Technology, Inc.
408 West Sixth Street
Bloomington, Indiana 47404

February 6, 2013

WEST Inc. Environmental & Statistical Consultants

NATURAL RESOURCES ◆ SCIENTIFIC SOLUTIONS

EXECUTIVE SUMMARY

Apex Wind Energy (Apex) is proposing to develop a wind energy facility, known as the Emerson Creek Wind Resource Area (ECWRA), in Seneca and Huron Counties, Ohio. Apex contracted Western EcoSystems Technology, Inc. (WEST) to conduct baseline surveys in the ECWRA. Survey design followed methods described in the final draft of wildlife study guidelines from the Ohio Department of Natural Resources.

Wildlife surveys, conducted from September 1, 2010 through August 30, 2011 at the ECWRA, fulfilled a portion of the methods recommended in final ODNR guidelines and included ground-based raptor nest surveys, passerine migration surveys, raptor migration surveys, bald eagle surveys, acoustic bat surveys, and incidental wildlife observations. The results of the acoustic bat surveys were presented in a separate final report. Breeding bird surveys and bat mist-netting surveys have also been recommended by the ODNR and have not been completed, to date.

The objective of the ground-based raptor nest surveys was to locate raptor nests in and within one mile of the ECWRA that may be subject to disturbance and/or displacement effects from the wind energy facility construction and/or operation. Seven active red-tailed hawk nests and nine inactive unknown raptor species nests were observed within the ECWRA. An additional seven active red-tailed hawk nests, six inactive unknown raptor species nests, and one inactive bald eagle nest, reported by the ODNR, were observed within one mile of the project boundary. The bald eagle nest was reported by ODNR and was found to be in good quality, but was inactive at the time of the raptor nest survey.

The objective of the passerine migration survey was to estimate the rate of use of the combined forest, shrub and wooded wetland habitats in the general project area by fall migrating birds. Passerine migration surveys were conducted at 16 points weekly during the fall and spring migration periods (September 1 – November 15, 2010, April 1 – May 31, 2011, and August 15 – September 1, 2011). Three hundred sixty-seven 10-min surveys were conducted and 117 unique species were observed. Overall bird use was higher in the fall (17.36 birds/plot/10-minute survey) than in the spring (13.45).

The objective of the raptor migration surveys was to estimate the overall rate of use of the ECWRA in the fall and spring by migrating diurnal raptors (defined here as kites, accipiters, buteos, harriers, eagles, and falcons). Raptor migration surveys were conducted three times per week at four surveys points during the fall (September 1 to October 29) and spring (March 15 to May 1). A total of 324 raptors, representing 11 species, were observed during fall and spring raptor migration surveys. Overall raptor use within the ECWRA was relatively higher during the spring (1.15 birds/observer hour) than in the fall (0.72). Buteos had the highest relative use of raptor subtypes during spring and fall (0.78 and 0.43 birds/observer hour).

Raptor migration and bald eagle migration rates collected at the ECWRA during the raptor migration surveys were lower than rates observed at Hawk Migration Association of North

America (HMANA) Hawkwatch sites in the same geographic region as the project. The results of the raptor migration surveys within the ECWRA show that raptor use rates were low compared to observations at other wind energy facilities across the U.S., and within the range of raptor use rates observed within the Midwest.

The objective of the bald eagle fixed-point surveys was to observe bald eagle use of the ECWRA, within three miles (4.8 km) of a documented bald eagle nest site. The nest was found to be in good quality, but inactive during the time of surveys. Bald eagle surveys were conducted at 10 points within three miles of the nest during the winter (September 1 to February 15) and breeding seasons (March 1 to August 31). A total of 374 20-min surveys were conducted during 38 visits and 79 unique bird species were observed. Eagles were observed during the breeding season (0.07 birds/plot/20-minute survey) and the winter (0.04 birds/plot/20-minute survey).

The objective of incidental wildlife observations was to provide use and occurrence information for wildlife seen outside of the standardized surveys. Thirty-seven bird species totaling 4,627 individuals within 283 separate groups during the study were recorded incidentally at the ECWRA. The most abundant species recorded incidentally was mallard (1,588 individuals) followed by red-tailed hawk (582) and ring-necked duck (572). Four mammal species were also recorded incidentally.

No federally-listed threatened or endangered species were observed during surveys within the ECWRA. Twenty-seven species designated as endangered (five species), threatened (six species), species of special concern (four species) or species of special interest (12 species) by the ODNR were observed during surveys and incidentally within the ECWRA.

The USFWS interim guidelines for wind energy development suggest that wind energy facilities should be sited within previously altered habitats, and the proposed wind energy facility is located within an area dominated by tilled agriculture (84.1%). To date, bird fatality rates reported at projects within agricultural regions of the Midwest have ranged from 0.42 to 8.25 birds per megawatt (MW) per study period with raptors composing 5.7% of the fatalities found. Based on data collected during the raptor migration surveys, raptor fatality rates at the ECWRA are expected to be similar to what has been observed in the Midwest.

The ability of methods recommended by the ODNR guidelines for predicting fatality rates of other bird species is untested. Relatively few post-construction studies of wind energy facilities in the Midwest are available for comparison and no post-construction studies of bird fatality rates at facilities in Ohio have been made public. The impacts of wind energy facilities on wildlife in Ohio will become more defined as the results of ongoing research become available.

STUDY PARTICIPANTS

Western EcoSystems Technology

Michelle Ritzert	Project Manager, Field Supervisor
Rhett Good	Senior Manager
Kimberly Bay	Data Analyst and Report Manager
Michelle Sonnenberg	Statistician
J.R. Boehrs	GIS Technician
Jason Ritzert	Report Compiler/Research Biologist
Andrea Palochak	Technical Editor
Aaron Rinker	Field Technician
Ryan Trimbath	Field Technician

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INTRODUCTION

Apex Wind Energy (Apex) is proposing to develop a wind energy facility, known as the Emerson Creek Wind Resource Area (ECWRA), in Seneca and Huron Counties, Ohio (Figure 1). Apex contracted Western EcoSystems Technology, Inc. (WEST) to conduct baseline surveys in the ECWRA. Survey design followed methods described in the final draft of wildlife study guidelines from the Ohio Department of Natural Resources (ODNR 2009).

Wildlife surveys, conducted from September 1, 2010 through August 30, 2011 at the ECWRA, included ground-based raptor nest surveys, passerine migration surveys, raptor migration surveys, bald eagle (*Haliaeetus leucocephalus*) surveys, acoustic bat surveys, and incidental wildlife observations. The results of the acoustic bat surveys were presented in a separate final report.

In addition to site-specific data, this report presents existing information and results of studies conducted at other wind energy facilities. The ability to estimate potential bird mortality at the proposed ECWRA is greatly enhanced by operational monitoring data collected at existing wind energy facilities. For several wind energy facilities, standardized data were collected in association with standardized post-construction (operational) monitoring, allowing comparisons of bird use with bird mortality. Where possible, comparisons with regional and local studies were made.

STUDY AREA

The ECWRA encompasses approximately 45,920 acres in Seneca and Huron Counties, Ohio and covers three Level III Ecoregions: the Eastern Corn Belt Plains Ecoregion, Huron/Erie Lake Plains and Erie/Ontario Drift and Lake Plain (USEPA 2007). The Eastern Corn Belt Plains Ecoregion is a rolling plain with local end moraines that originally had more natural tree cover than the Central Corn Belt Plains, and has loamier and better drained soils than the Huron/Erie Lake Plains. The Huron/Erie Lake Plains Level III Ecoregion encompasses much of northwestern Ohio and is a broad, fertile, and nearly flat plain punctuated by relict sand dunes, beach ridges, and end moraines (USEPA 2007). A small portion of the ECWRA also occurs within the Erie/Ontario Drift and Lake Plain, which is characterized by a flat coastal strip of lacustrine deposits punctuated by beach ridges and swales. Elevations in the ECWRA range from 230 – 280 meters (m; 755 – 919 feet [ft]) above mean sea level (Figure 1).

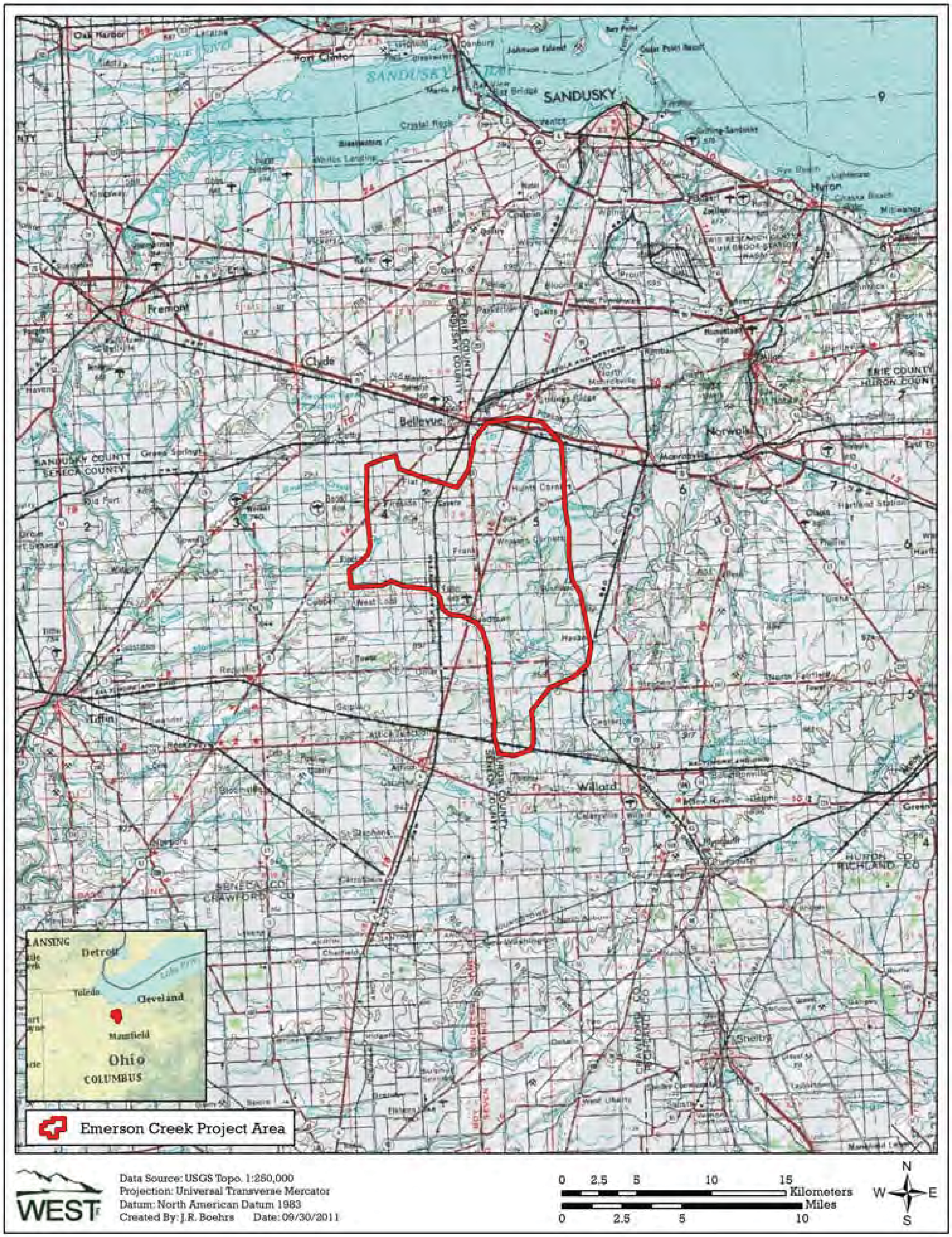

Figure 1. Location of the Emerson Creek Wind Resource Area.

According to the National Landcover Dataset (USGS NLCD 2001; Table 1, Figure 2), the dominant cover type within the ECWRA is cultivated cropland (corn [*Zea mays*] and soybean [*Glycine max*]), composing 84.1% (38,565 acres) of the total land area. The second most common cover type is deciduous forest, (8.4%; 3,859 acres), followed by developed areas (5.7%; 2,604 acres). Developed areas are generally confined to residences and farms scattered throughout the ECWRA. Pasture/hay, barren areas, open water, grasslands, mixed forest, emergent wetlands, evergreen forests, and woody wetlands make up 1% or less of the total area individually (Table 1).

Table 1. Summary of habitats according to the National Landcover Dataset within the Emerson Creek Wind Resource Area.

Habitat Type	Acres	% Composition
Agriculture	38,565.00	84.1
Deciduous Forest	3,858.65	8.4
Developed, Open Space	2,142.62	4.7
Pasture/Hay	436.15	1.0
Developed, Low Intensity	406.53	0.9
Barren	239.57	0.5
Open Water	133.93	0.3
Grassland	73.45	0.2
Developed, Medium Intensity	48.32	0.1
Developed, High Intensity	6.89	< 0.1
Mixed Forest	2.59	< 0.1
Emergent Wetlands	2.37	< 0.1
Evergreen Forest	2.29	< 0.1
Woody Wetlands	1.51	< 0.1
Total	**45,919.86**	**100**

Data from USGS NLCD 2001

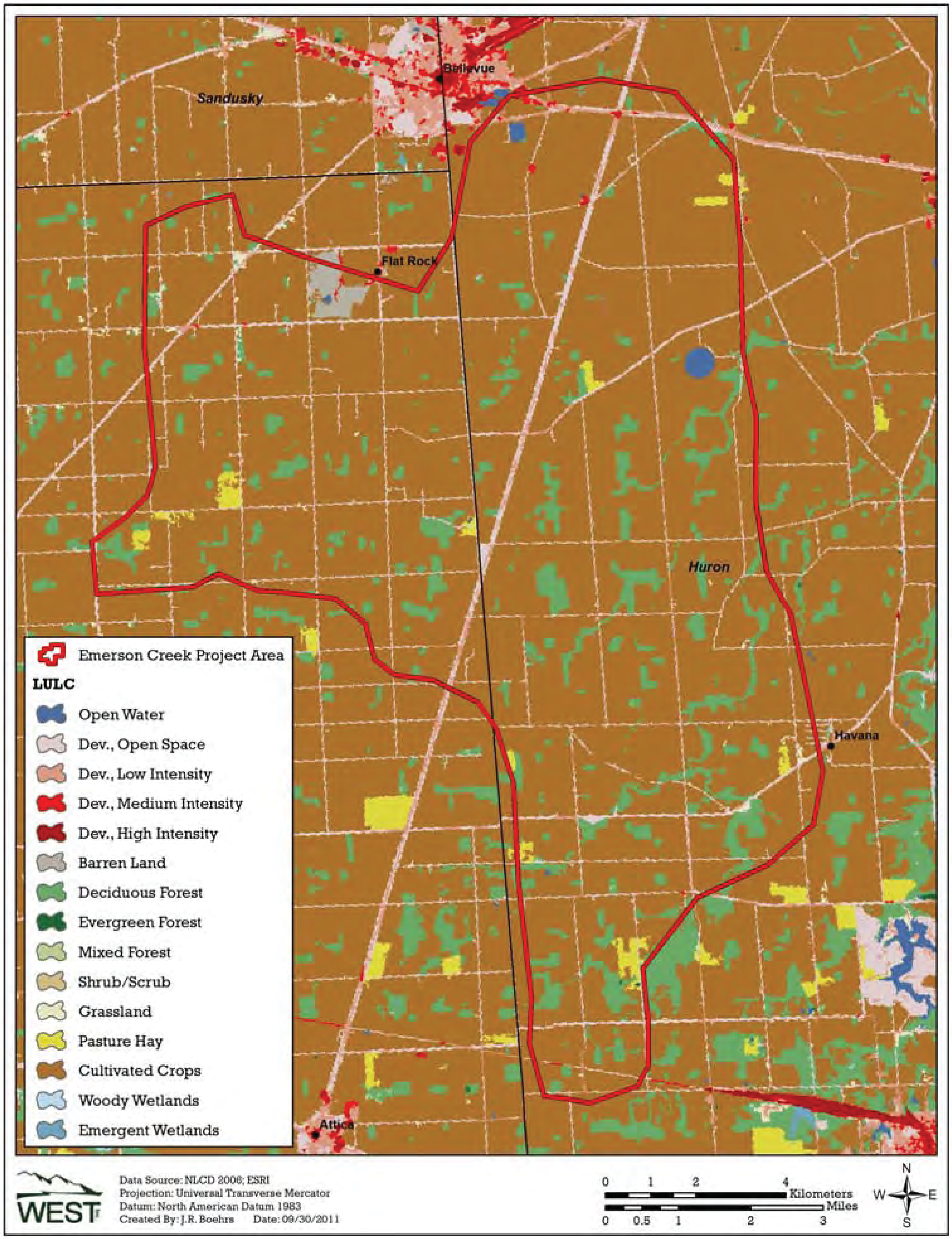

Figure 2. The land cover types and coverage within Emerson Creek Wind Resource Area (USGS NLCD 2006).

METHODS

The study at the ECWRA consisted of the following study components: 1) ground-based raptor nest surveys; 2) passerine migration surveys; 3) diurnal bird/raptor migration surveys; 4) bald eagle surveys; and 5) incidental wildlife observations.

Ground-Based Raptor Nest Surveys

The objective of the ground-based raptor nest surveys was to locate raptor nests in and within one mile (1.6 kilometers [km]) of the ECWRA that may be subject to disturbance and/or displacement effects from the wind energy facility construction and/or operation.

Suitable raptor nesting habitat is present in the ECWRA in the form of deciduous trees, shelterbelts, grasslands, and man-made structures such as power poles. One survey for raptor nests, including potential northern harrier (*Circus cyaneus*) nests, was conducted by searching suitable nesting areas from public roads with binoculars and spotting scopes. Areas of leased land not viewable from public roads were searched on foot. All areas within the ECWRA and one-mile (1.6 kilometer [km]) buffer were searched Potential nest locations were recorded on recent aerial photographs, and digitized in a geographical information system (GIS), ArcGIS 10.

Data recorded for each nest site included nest status (active or inactive), the number of adults and young present, species occupying nest site, behavior of adults at the nest, nest condition (poor, fair, good), nest location (global positioning system [GPS] coordinates) and nest substrate.

Passerine Migration Survey

The objective of the passerine migration survey was to estimate the rate of use of the combined forest, shrub and wooded wetland habitats in the general project area by migrating birds. Passerine migration survey data consisted of counts of birds observed within circular plots around fixed observation points following similar methods as Reynolds et al. (1980).

Passerine Migration Survey Plots

Per ODNR recommendations, 16 points were placed on leased lands within forested and shrub habitats in the proposed ECWRA (Figure 3). The radius of the survey plot included areas up to 200 m (656 ft), depending on terrain limitations.

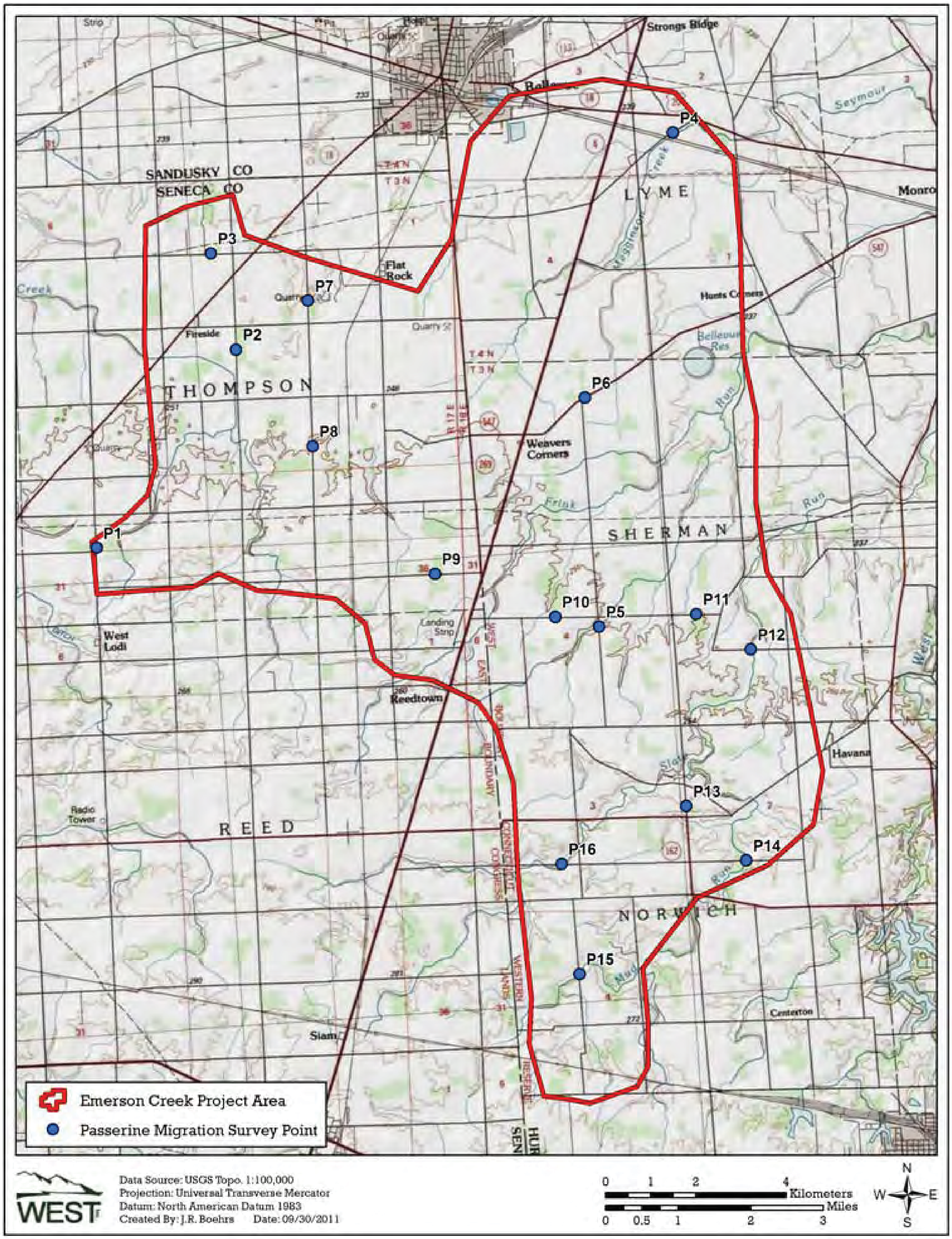

Figure 3. Overview of the passerine migration survey points at the Emerson Creek Wind Resource Area.

Passerine Migration Survey Methods

All species of birds observed during each 10-minute survey were recorded. Each bird's estimated distance from the observer was recorded to the nearest meter (3.3 ft). Any bird flying over the plot that did not originate from or land within 200 m (656 ft) of the center of the plot was recorded as a "fly over". The flight direction of observed birds was also recorded. Approximate flight height above ground level (AGL) at first observation was also recorded to the nearest meter (3.3 ft) and the approximate lowest and highest flight heights observed was also recorded.

The behavior of each bird observed during the surveys was recorded. Behavior categories recognized include perched, soaring, flapping, flushed, circle soaring, hunting, gliding, and other (noted in comments). Any comments or unusual observations were noted in the comments section. Weather information, including temperature (degrees Fahrenheit [°F]), wind speed (miles per hour [mph]), wind direction and cloud cover (percentage [%]), was recorded for each survey point. The date, start, and end time of observation period, plot number, species or best possible identification, number of individuals, sex and age class if possible, distance from plot center when first observed (m), closest distance (m), height (m), and activity were recorded.

Observation Schedule

Passerine migration surveys were conducted during the fall and spring migration periods (September 1 – November 15, 2010, April 1 – May 31, 2011, and August 15 – September 1, 2011). Surveys were conducted weekly during daylight hours between 0600 and 1000 hours (hrs).

Raptor Migration Surveys

The objective of the raptor migration surveys was to estimate the overall rate of use of the ECWRA in the fall and spring by diurnal raptors (defined here as kites, accipiters, buteos, harriers, eagles, and falcons). Raptor migration surveys consisted of counts of birds observed within circular plots around fixed observation points and followed similar methods of Reynolds et al. (1980).

Raptor Migration Survey Plots

In a letter dated June 9, 2010, the ODNR recommended one point count location be monitored for raptor migration surveys; however, to obtain greater spatial coverage of the ECWRA, four survey points were placed in the ECWRA (Figure 4). Survey points were evenly distributed across the ECWRA and selected to maximize viewsheds 360° around the point.

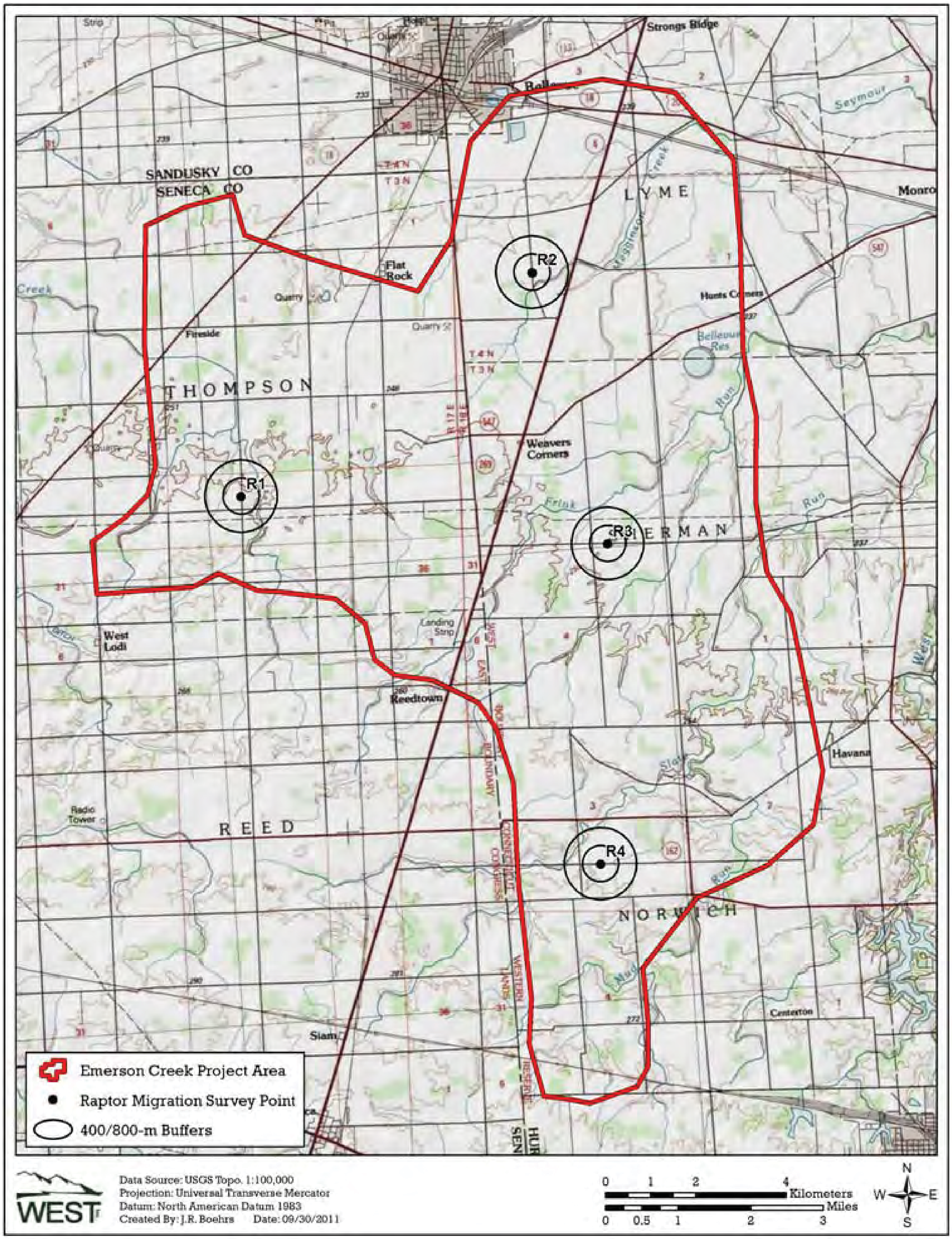

Figure 4. Overview of the raptor migration survey points at the Emerson Creek Wind Resource Area.

Raptor Migration Survey Methods

Points were surveyed for 1.75 hrs each survey day, for a total of seven hrs of observation per survey day. All birds observed were recorded (an unlimited viewshed), and observation methods typical of raptor migration surveys, Hawk Watch sites (e.g., Hawk Migration Association of America [HMANA] and Hawk Watch International [HWI]), were used. Surveyors continuously scanned the sky and surrounding areas using binoculars or a spotting scope to help see and identify birds. Surveyors concentrated on finding and identifying raptors during the surveys; however, for the first 10 minutes of each survey, all birds were recorded. After the initial 10 minutes, only large birds, raptors, and unique and sensitive species were recorded.

The date, start time and end time of the observation period, and weather information (e.g., air temperature [°F], wind speed (mph), wind direction, could cover (%), and precipitation) were recorded for each survey. All raptors, other large diurnal migrants, and sensitive species recorded were assigned a unique observation number. Time of observation, species or best possible identification, number of individuals, age and sex (if possible), approximate distance from point when observed (m), approximately altitude (m) approximate flight direction, activity (behavior), and habitat(s) or topographic features the bird was flying over were recorded for each observation. Locations of raptors, other large birds, and any species of interest seen were recorded on the field maps by observation number. The field maps were prepared as portions of recent aerial photographs, which included the survey plot.

The behavior of each bird observed during the surveys was recorded. Behavior categories recognized were the same as the passerine migration surveys and included perching, soaring, flapping, flushed, circle soaring, hunting, gliding and other (noted in comments). Any comments or unusual observations were noted in the comments section. The time spent flying within the estimated rotor swept height (RSH) was also recorded for each observation.

Observation Schedule

Raptor migration surveys were conducted three times per week during the fall and spring migration period (September 1 to October 29 and March 15 to May 1). To the extent practical, all surveys were conducted between 0900 – 1600 hrs, and each plot was surveyed during various times of day to ensure all parts of the day were surveyed at each point.

Bald Eagle Fixed-Point Surveys

The objective of the bald eagle fixed-point surveys was to observe bald eagle use of the ECWRA, within three miles (4.8 km) of a documented bald eagle nest site. According to the ODNR, a bald eagle nest was reported along Slate Run, a tributary of the Huron River, located just outside of the eastern border of the ECWRA. Bald eagles are listed as a state threatened species and are also protected under the Bald and Golden Eagle Protection Act (BGEPA 1940). Fixed-point surveys (variable circular plots) were conducted using methods similar to Reynolds et al. (1980).

Bald Eagle Survey Plots

Ten points were established within three miles of the documented nest location to survey bald eagle use near the site (Figure 5). Survey points were placed along three transects and spaced at increasing distances from the nest (approximately every mile [5,280 ft]). Each survey plot was an 800 m (2,625ft) radius circle centered on the point.

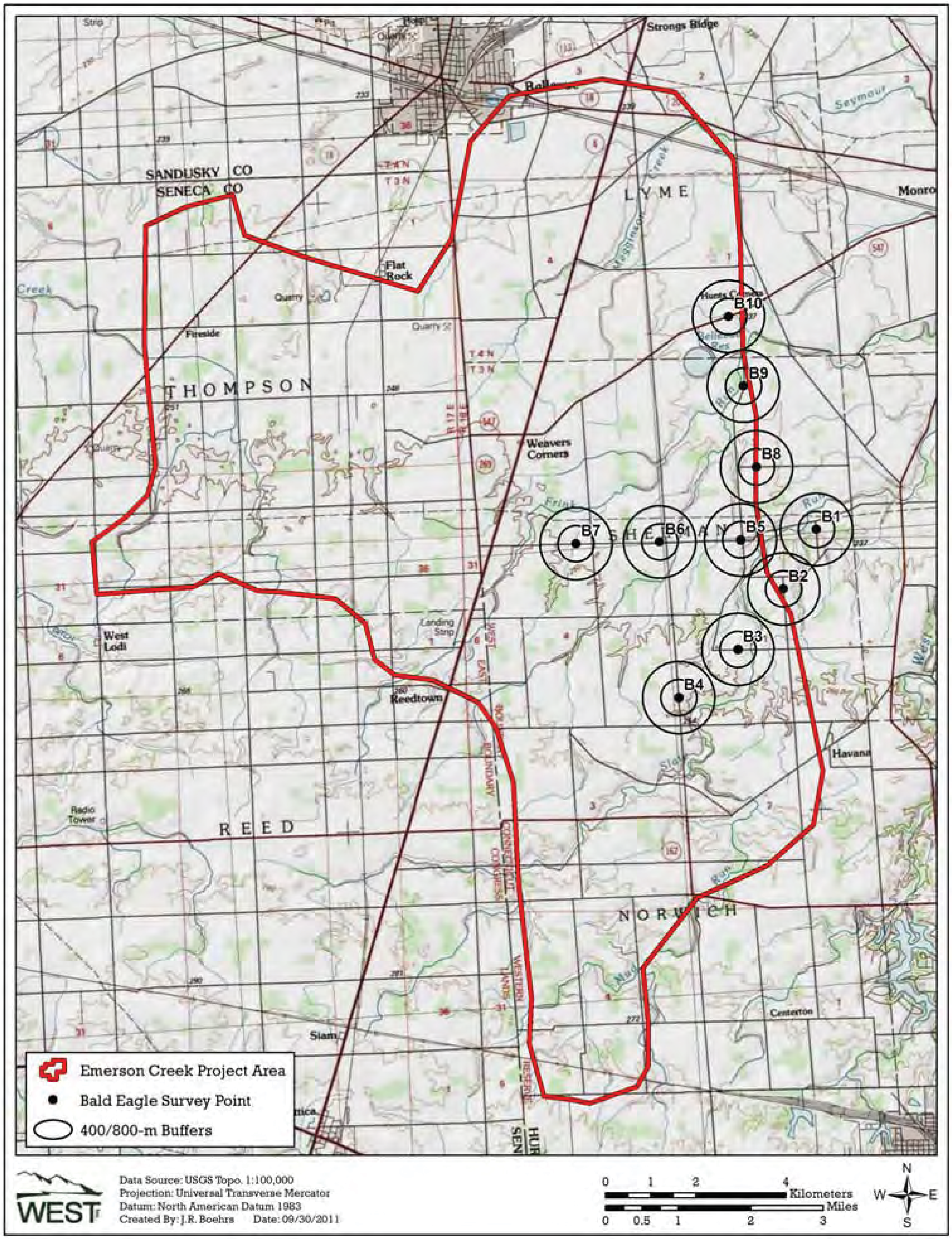

Figure 5. Overview of the bald eagle survey points at the Emerson Creek Wind Resource Area.

Bald Eagle Survey Methods

All species of birds observed during each 20-minute survey were recorded, although surveyors focused efforts on recording bald eagles. Observations were categorized by bird size (large or small). Large birds included waterbirds, waterfowl, rails/coots, shorebirds, diurnal raptors, owls, vultures, upland game birds, doves/pigeons, and large corvids (e.g., ravens, magpies, and some crows). Passerines (excluding large corvids), swifts/hummingbirds, woodpeckers, and cuckoos were considered small birds.

The date, start and end time of the survey period, and weather information (e.g., temperature [°F], wind speed [mph], wind direction, cloud cover [%], and precipitation) were recorded for each survey. Species or best possible identification, number of individuals, sex and age class (if possible), distance from plot center when first observed (m), closest distance (m), altitude above ground (m), activity (behavior), and habitat(s) were recorded for each observation. Behavior and habitat type were recorded based on the point of first observation. Approximate flight height and distance from plot center at first observation were recorded to the nearest 5 m (16 ft) interval. Other information recorded included whether or not the observation was auditory only and the 10-minute interval of the 20-minute survey in which the observation was initially noted.

Observation Schedule

Sampling intensity was designed to document bald eagle use during the USFWS defined winter (September 1 to February 15) and breeding seasons (March 1 to August 31) within the ECWRA. Surveys were conducted during all daylight hours and survey periods were varied to approximately cover all daylight hours during a season. To the extent practical, each point was surveyed approximately the same number of times.

Incidental Wildlife Observations

The objective of incidental wildlife observations was to provide use and occurrence information for wildlife seen outside of the standardized surveys. Wildlife observations, especially large birds (raptors, shorebirds, waterfowl, waterbirds, upland game birds), and unusual species (such as state listed or sensitive-status species, mammals, reptiles, and amphibians) sighted while observers were traveling between plots or on the ECWRA were recorded. The observation number, date, time, species, number of individuals, sex/age class, and habitat were recorded. Observations of threatened, endangered, or sensitive species were recorded in additional detail, mapped on a US Geological Survey (USGS) quadrangle map or GPS coordinates by the unique observation number, and summarized.

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 field surveys, observers were responsible for inspecting data forms for completeness, accuracy, and legibility. A sample of records from an electronic database was compared to the raw data forms and any errors detected were corrected. Irregular codes or data suspected as 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® ACCESS database was developed to store, organize, and retrieve survey data. Data were keyed into the electronic database using a pre-defined format to facilitate subsequent QA/QC and data analysis. All data forms and electronic data files were retained for reference.

Passerine Migration Surveys

Bird Diversity and Species Richness

Bird diversity was illustrated by the total number of unique species observed. Species lists, with the number of observations and the number of groups, were generated by season, including all observations of birds detected regardless of their distance from the observer. Species richness was calculated as the mean number of species observed per survey (i.e., number of species/plot/10-minute survey). Species richness was compared between seasons for migrating songbird use surveys.

Bird Use, Composition, and Frequency of Occurrence

For the standardized passerine migration survey estimates, only observations of birds detected within the 100 m (328 ft) radius plot were used for statistical analysis. Estimates of mean bird use (i.e., number of birds/plot/10-minute survey) were used to compare differences between bird types and seasons.

The frequency of occurrence was calculated as the percent of surveys in which a particular species/bird type was observed. Percent composition was calculated as the proportion of the overall mean use for a particular species/bird type. Frequency of occurrence provides relative estimates of species exposure to the wind energy facility. For example, a species may have high use estimates for the proposed wind resource area based on just a few observations of large groups; however, the frequency of occurrence will indicate that the species occurs during very few of the surveys, and therefore may be less likely affected by the wind energy facility.

Raptor Migration Surveys

Bird Diversity and Species Richness

Bird diversity was represented by the total number of unique species observed. Species lists, with the number of individual observations and the number of groups, were generated for the fall season. Species richness was calculated as the mean number of species observed per survey (i.e., number of species/survey).

Bird Use, Composition, and Frequency of Occurrence

Typically, bird use by species or bird type is calculated as the mean number of observations per 20-minute survey within a certain distance of the survey point or station. For raptor migration surveys, this is often reported as the mean number of raptors per observer hour of survey within an unlimited viewshed. These types of metrics allow standardized comparison between sample locations, time (hours, days, weeks, seasons), or with other studies where similar data exist. Bird use is reported both ways in this report to allow for comparisons.

The frequency of occurrence was calculated as the percent of surveys in which a particular species or bird type is observed. Percent composition was calculated as the proportion of the overall mean use for a particular species or bird type. Frequency of occurrence and percent composition provide relative estimates of species exposure to the proposed wind energy facility. For example, a species may have high use estimates for the site based on just a few observations of large groups; however, the frequency of occurrence will indicate that the species occurs during very few of the surveys and, therefore, may be less likely to be affected by the facility.

Bird Flight Height and Behavior

To calculate potential risk to flying birds, the first flight height recorded was used to estimate the percentages of birds flying within the likely RSH of potential turbines that may be constructed at the ECWRA. A RSH of 20 to 120 m (66 to 394 ft) was used for the analysis, per ODNR guidelines (ODNR 2009).

Bald Eagle Surveys

Bird Diversity and Species Richness

Bird diversity was illustrated by the total number of unique species observed. Species lists (with the number of observations and the number of groups) were generated for the fall season and included all observations of birds detected, regardless of their distance from the observer. Species richness was calculated as the mean number of species observed per plot per survey (i.e., number of species/plot/20-minute survey).

Bird Use, Percent Composition, and Frequency of Occurrence

For the standardized use estimates, only observations of large birds detected within the 800 m radius plot were used in the analysis. For small birds, only observations within a 100 m radius were used. Estimates of mean bird use (i.e., number of birds/plot/20-minute survey) were used to compare differences between bird types, survey points, and other wind energy facilities. Mean use was calculated by determining the number of birds seen within each 800 m plot (or 100 m plot for small birds) for each given visit, and then averaging by the number of plots surveyed during that visit. A second averaging occurred across the number of visits during the entire study period. A visit was defined as the required length of time to survey all of the plots once within the study area.

Percent composition was calculated as the proportion of the overall mean use for a particular bird type or species, and the frequency of occurrence was calculated as the percent of surveys in which a particular bird type or species was observed. Frequency of occurrence and percent composition provided relative measures of species use of the proposed wind resource area. For example, a particular species might have relatively high use estimates for the study area, based on just a few observations of large groups. However, the frequency of occurrence would indicate that the species only occurred during a few of the surveys, and therefore the species would be less likely to be affected by the wind energy facility or the transmission corridor.

Bird Flight Height and Behavior

To calculate potential risk to bird species, the first flight height recorded was used to estimate the percentages of birds flying within the likely RSH for collision with turbine blades of 20 to 120 m, per ODNR guidelines (ODNR 2009).

Spatial Use

Bald eagle flight paths were qualitatively compared to study area characteristics (e.g., topographic features). The objective of mapping observed bald eagle locations and flight paths was to identify areas of concentrated use by eagles and/or consistent flight patterns within the study area. This information can be useful in turbine layout design or adjustments of individual turbines for micro-siting.

RESULTS

Surveys were completed at the ECWRA from September 1, 2010 through August 30, 2011. Results of ground-based raptor nest surveys, passerine migration surveys, raptor migration surveys, and bald eagle surveys, and incidental surveys are discussed below.

Ground-Based Raptor Nest Surveys

Seven active red-tailed hawk (*Buteo jamaicensis*) nests and nine inactive unknown raptor species nests were observed within the ECWRA (Figure 6). An additional seven active red-tailed hawk nests and six inactive unknown raptor species nests were observed within one mile of the project boundary. The inactive unknown raptor species nests were likely constructed by red-tailed hawks, based on their size and the relative abundance of this species in the ECWRA; however, the nests could also be used by other raptor species, such as Cooper's hawk (*Accipiter cooperii*) or great horned owl (*Bubo virginianus*). The ODNR reported bald eagle nest was inactive during the surveys.

It is important to note that raptor nest locations were mapped on recent aerial photographs, and digitized in to ArcGIS 10. The locations were not recorded with a sub-meter GPS, and some error is associated with each location. Locations are estimated to be accurate to within 50 – 100 m (164 – 328 ft) of the coordinate.

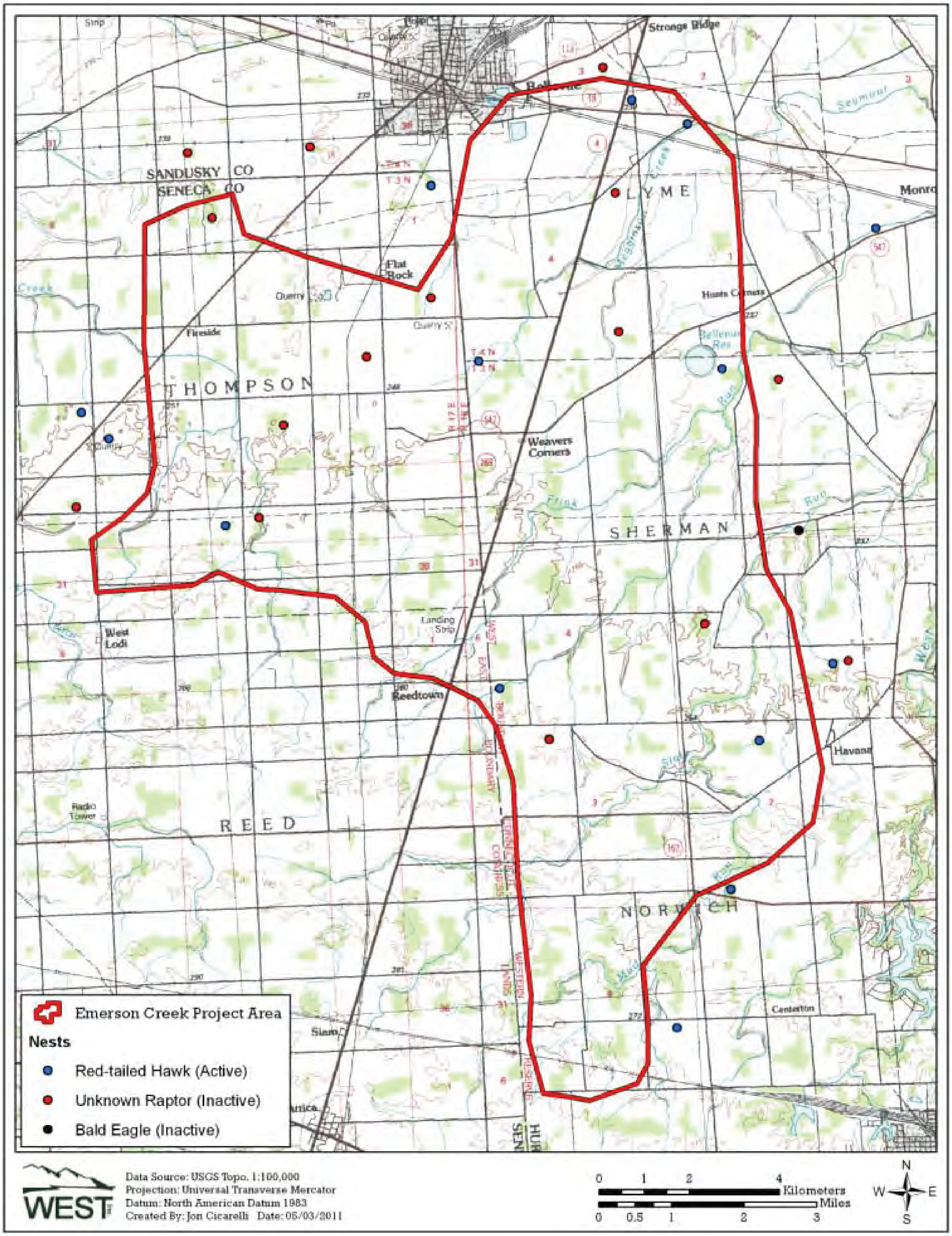

Figure 6. Raptor Nest Locations at the Emerson Creek Wind Resource Area.

Passerine Migration Survey

Passerine migration surveys were conducted at the ECWRA from September 1 to November 10, 2010, April 5 to May 28, 2011, and August 9 to August 30, 2011. Three hundred sixty-seven 10-min surveys were conducted over 25 visits in the spring and fall.

Bird Diversity and Species Richness

A total of 5,885 individual bird observations within 2,570 separate groups were recorded during passerine migration surveys (Appendix A). Cumulatively, five species (4.3% of all species) comprised 33.8% of the individual observations: American robin (*Turdus migratorius*; 674 observations), European starling (*Sturnus vulgaris*; 465), common grackle (*Quiscalus quiscula*; 345), American goldfinch (*Carduelis tristis*: 288), and red-winged blackbird (*Agelaius phoeniceus*; 219). All other bird species composed 2.2% or less of the observations individually.

Bird Use, Composition, and Frequency of Occurrence by Species and Type

Mean bird use, percent composition, and frequency of occurrence by season were calculated. Overall bird use was higher in the fall (17.36 birds/plot/10-minute survey) than in the spring (13.45; Table 2).

Table 2. Mean bird use (number of birds/plot[a]/10-minute survey), percent of total composition (%), and frequency of occurrence (%) for each major bird type and passerine subtypes by season during passerine migration surveys at the Emerson Creek Wind Resource Area from September 1, 2010, to August 30, 2011.

	Mean Use		% Composition		% Frequency	
Bird Type / Subtype	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**
Waterbirds	0.30	0.03	1.7	0.3	2.1	3.5
Waterfowl	0.41	0.21	2.4	1.6	3.4	10.3
Shorebirds	0.05	0.08	0.3	0.6	2.1	4.4
Gulls/Terns	0.05	0	0.3	0	0.4	0
Rails/Coots	<0.01	0	<0.1	0	0.4	0
Diurnal Raptors	0.08	0.07	0.4	0.5	7.1	7.3
Vultures	0.08	0.21	0.4	1.5	5.4	10.2
Upland Game Birds	<0.01	<0.01	<0.1	<0.1	0.8	0.6
Doves/Pigeons	0.49	0.16	2.8	1.2	17.6	13.7
Passerines	14.78	11.99	85.2	89.1	97.9	100
Blackbirds/Orioles	*5.60*	*4.44*	*32.2*	*33.0*	*29.2*	*80.9*
Corvids	*1.14*	*0.97*	*6.6*	*7.2*	*47.6*	*45.6*
Creepers/Nuthatches	*0.46*	*0.18*	*2.7*	*1.4*	*31.5*	*13.1*
Finches/Crossbills	*0.94*	*0.55*	*5.4*	*4.1*	*30.1*	*30.0*
Flycatchers	*0.28*	*0.33*	*1.6*	*2.4*	*22.1*	*24.7*
Gnatcatchers/Kinglet	*0.20*	*0.19*	*1.1*	*1.4*	*6.8*	*11.8*
Grassland/Sparrows	*1.29*	*1.32*	*7.4*	*9.8*	*29.3*	*81.6*
Mimids	*0.23*	*0.40*	*1.3*	*3.0*	*15.0*	*29.3*
Swallows	*0.31*	*0.25*	*1.8*	*1.9*	*10.0*	*14.2*
Tanagers/Grosbeaks/Cardinals	*0.48*	*0.78*	*2.7*	*5.8*	*28.0*	*53.1*
Thrushes	*2.23*	*1.52*	*12.9*	*11.3*	*49.8*	*72.0*
Titmice/Chickadees	*0.52*	*0.29*	*3.0*	*2.2*	*19.7*	*20.7*
Vireos	*0.08*	*0.06*	*0.5*	*0.5*	*5.8*	*6.1*
Warblers	*0.78*	*0.33*	*4.5*	*2.5*	*20.6*	*20.7*
Waxwings	*0.16*	*0*	*0.9*	*0*	*3.3*	*0*

Table 2. Mean bird use (number of birds/plot[a]/10-minute survey), percent of total composition (%), and frequency of occurrence (%) for each major bird type and passerine subtypes by season during passerine migration surveys at the Emerson Creek Wind Resource Area from September 1, 2010, to August 30, 2011.

	Mean Use		% Composition		% Frequency	
Bird Type / Subtype	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**
Wrens	*0.05*	*0.28*	*0.3*	*2.1*	*4.6*	*26.2*
Other Passerines	*0.04*	*0.09*	*0.2*	*0.7*	*2.9*	*7.5*
Swifts/Hummingbirds	0.04	0	0.2	0	3.4	0
Woodpeckers	1.05	0.67	6.1	5.0	46.0	48.7
Kingfishers	0.01	0.03	<0.1	0.2	1.2	2.0
Overall	**17.36**	**13.45**	**100**	**100**		

[a.] 200-m plot regardless of bird size.

Passerines

Passerines use was higher in the fall than in the spring (14.78 and 11.99 birds/plot/10-min survey, respectively; Table 2). Blackbirds/orioles, corvids, creepers/nuthatches, finches/crossbills, swallows, thrushes, titmice/chickadees, warblers, and waxwings had relatively higher mean use during the fall, while flycatchers, grassland sparrows, mimids, tanagers/grosbeaks/cardinals, and wrens had a relatively higher mean use during the spring (Table 2). Passerines were observed during 100% of spring surveys and 97.9% of fall surveys and comprised over 85% of overall bird use during both seasons (Table 2).

Sensitive Species Observations

No federally-listed threatened or endangered species were observed during passerine migration surveys within the ECWRA. Two state-listed endangered species, northern harrier (two observations) and yellow-bellied sapsucker (four) were observed during passerine migration surveys (Table 3). Additionally, three state-listed threatened species (dark-eyed junco [*Junco hyemalis*; 78], hermit thrush [*Catharus guttatus*; eight], and least flycatcher [*Empidonax minimus*; one]), two species of special concern (great egret [*Ardea alba*; one] and sharp-shinned hawk [one]), and six species of special interest (golden-crowned kinglet [*Regulus satrapa*; 54], magnolia warbler [*Dendrocia magnolia*; 11], brown creeper [*Certhia americana*; nine], Canada warbler [*Wilsonia canadensis*; two], black-throated blue warbler [*Dendrocia caerulescens*; one], and red-breasted nuthatch [*Sitta Canadensis*; one]) were observed.

Table 3. Summary of sensitive species observed at the Emerson Creek Wind Resource Area during passerine migration surveys (PMS), raptor migrations surveys (RMS), bald eagle surveys (BAEA), and as incidental wildlife observations (Inc.) from September 1, 2010, to August 30, 2011.

			PMS		RMS		BAEA		Inc.		Overall	
Species	Scientific Name	Status	# of Grps.	# of Obs.	# of Grps.	# of Obs.	# of Grps.	# of Obs.	# of Grps.	# of Obs.	# of Grps.	# of Obs.
American wigeon	*Anas americana*	SSI	0	0	0	0	0	0	9	471	9	471
northern pintail	*Anas acuta*	SSI	0	0	1	1	0	0	7	447	8	448
northern harrier	*Circus cyaneus*	SE	2	2	32	32	18	18	21	120	73	172
bald eagle	*Haliaeetus leucocephalus*	ST, EA	0	0	37	38	22	22	24	28	83	88
dark-eyed junco	*Junco hyemalis*	ST	16	78	0	0	2	8	0	0	18	86
golden-crowned kinglet	*Regulus satrapa*	SSI	19	54	0	0	0	0	0	0	19	54
northern shoveler	*Anas clypeata*	SSI	0	0	0	0	0	0	6	41	6	41
green-winged teal	*Anas crecca*	SSI	0	0	0	0	0	0	5	39	5	39
great egret	*Ardea alba*	SSC	1	1	1	2	6	6	3	8	11	17
ruddy duck	*Oxyura jamaicensis*	SSI	0	0	0	0	0	0	3	11	3	11
magnolia warbler	*Dendroica magnolia*	SSI	8	11	0	0	0	0	0	0	8	11
bobolink	*Dolichonyx oryzivorus*	SSC	0	0	0	0	10	10	0	0	10	10
brown creeper	*Certhia americana*	SSI	7	9	0	0	0	0	0	0	7	9
hermit thrush	*Catharus guttatus*	ST	4	8	0	0	0	0	0	0	4	8
sharp-shinned hawk	*Accipiter striatus*	SSC	1	1	4	4	2	2	0	0	7	7
Henslow's sparrow	*Ammodramus henslowii*	SSC	0	0	0	0	1	5	0	0	1	5
yellow-bellied sapsucker	*Sphyrapicus varius*	SE	4	4	0	0	0	0	0	0	4	4
Wilson's snipe	*Gallinago delicata*	SSI	0	0	1	1	0	0	2	2	3	3
lark sparrow	*Chondestes grammacus*	SE	0	0	0	0	2	3	0	0	2	3
osprey	*Pandion haliaetus*	ST	0	0	1	1	2	2	0	0	3	3
sandhill crane	*Grus canadensis*	SE	0	0	1	3	0	0	0	0	1	3
Canada warbler	*Wilsonia canadensis*	SSI	2	2	0	0	0	0	0	0	2	2
snowy egret	*Egretta thula*	SE	0	0	0	0	0	0	1	1	1	1
black-throated blue warbler	*Dendroica caerulescens*	SSI	1	1	0	0	0	0	0	0	1	1
least flycatcher	*Empidonax minimus*	ST	1	1	0	0	0	0	0	0	1	1
peregrine falcon	*Falco peregrinus*	ST	0	0	1	1	0	0	0	0	1	1
red-breasted nuthatch	*Sitta canadensis*	SSI	1	1	0	0	0	0	0	0	1	1
Overall	**27 species**		**67**	**173**	**80**	**90**	**66**	**103**	**81**	**1,168**	**294**	**1,534**

EA=protected under the federal Bald and Golden Eagle Protection Act; SE=state endangered; ST=state threatened; SSC=state species of concern; SSI=state species of special interest

Raptor Migration Surveys

Raptor migration surveys were conducted at four stations within the ECWRA 26 times in the fall (September 1 and October 29, 2010) and 21 times in the spring (March 17 and April 29, 2011).

Bird Diversity and Species Richness

A total of 324 raptors, representing 11 species, were observed during fall and spring raptor migration surveys (Appendix B).

Bird Use, Composition, and Frequency of Occurrence by Season

Overall raptor use within the ECWRA was relatively higher during the spring (1.15 birds/observer hour) than in the fall (0.72 birds/observer hour; Table 4). Buteos (primarily red-tailed hawk) had the highest relative use of raptor subtypes during spring and fall (0.78 and 0.43 birds/observer hour; Table 4). During the fall, raptors made up 4.1% of bird use, but were recorded during 68.9% of all surveys. During the spring, raptor use was slightly lower (2.3%); however, raptors were observed during 67.9% of all surveys (Table 4).

Table 4. Mean bird use (number of birds/observer hour/survey), percent of use (%), and frequency of occurrence (%) for each bird type and raptor subtype during fall 2010 and spring 2011 raptor migration surveys at the Emerson Creek Wind Resource Area.

	Mean Use		% of Use		% Frequency	
Bird Type / Subtype	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**
Waterbirds	<0.01	0.11	<0.1	0.2	1.9	11.9
Waterfowl	0.31	32.91	1.8	64.5	9.6	27.4
Shorebirds	0.62	0.69	3.6	1.4	37.2	29.8
Gulls/Terns	<0.01	0.36	<0.1	0.7	1.0	4.8
Diurnal Raptors	0.72	1.15	4.1	2.3	68.9	67.9
Accipiters	*0.07*	*0.05*	*0.4*	*<0.1*	*13.5*	*7.1*
Buteos	*0.43*	*0.78*	*2.5*	*1.5*	*47.1*	*57.1*
Northern Harrier	*0.07*	*0.08*	*0.4*	*0.1*	*15.7*	*13.1*
Eagles	*0.06*	*0.16*	*0.4*	*0.3*	*8.7*	*15.5*
Falcons	*0.07*	*0.02*	*0.4*	*<0.1*	*11.5*	*3.6*
Osprey	*<0.01*	*0*	*<0.1*	*0*	*1.0*	*0*
Other Raptors	*0.01*	*0.07*	*<0.1*	*0.1*	*2.2*	*9.5*
Vultures	3.30	3.99	19.0	7.8	85.3	84.5
Upland Game Birds	0.13	0.04	0.7	<0.1	3.8	3.6
Doves/Pigeons	0.19	0.02	1.1	<0.1	20.2	2.4
Passerines	11.99	11.70	68.9	22.9	99.0	78.6
Swifts/Hummingbirds	0.12	0	0.7	0	15.4	0
Woodpeckers	<0.01	0.03	<0.1	<0.1	1.9	4.8
Overall	**17.40**	**51.00**	**100**	**100**		

Fall raptor activity varied throughout the study season (Figure 7). Several peaks were observed during the fall: September 3 (8 observations), September 8 (11 observations), September 20 (13 observations), October 4 (9 observations), and October 22 (8 observations; Figure 7). No raptors were observed on October 20. Fall vulture activity showed several peaks in activity when 40 or more vultures were observed each day (September 10, 13, 22, 24, and 29). After September 29, fall vulture activity declined.

Larger peaks in spring raptor activity were observed at the ECWRA compared to fall activity. In spring, greater than ten raptors were observed on seven dates each (March 7, 18, 21, 23, April 1, 6, and 15; Figure 8). No raptors were observed on April 4 and 25. Vulture activity in the spring was variable; however, five survey days had more than 40 vultures observed each (March 18, April 12, 13, 20, and 27: Figure 8). No vulture observations were made on April 15 (Figure 8).

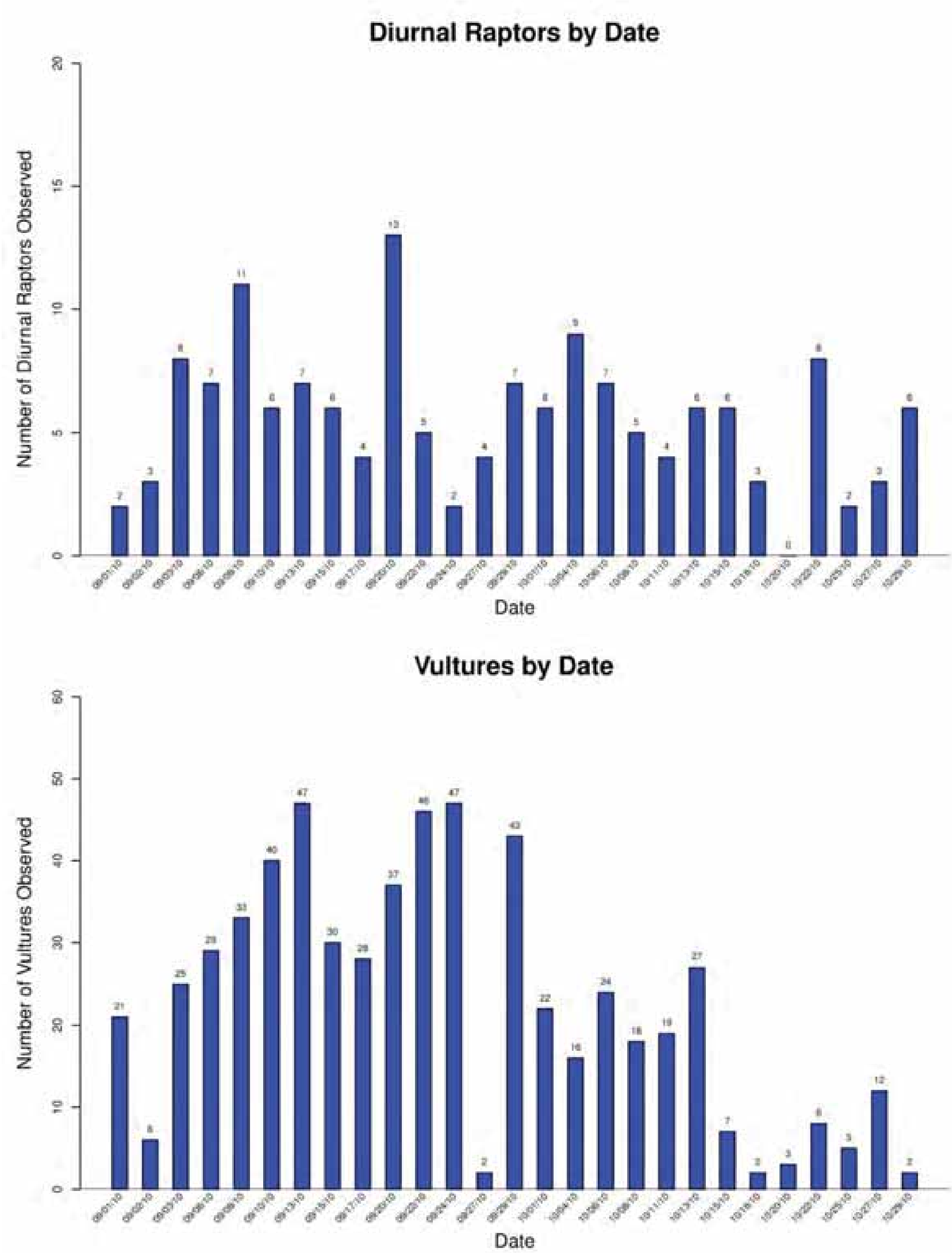

Figure 7. Total number of observations by survey day for raptors and vultures during the fall season raptor migration surveys at the Emerson Creek Wind Resource Area.

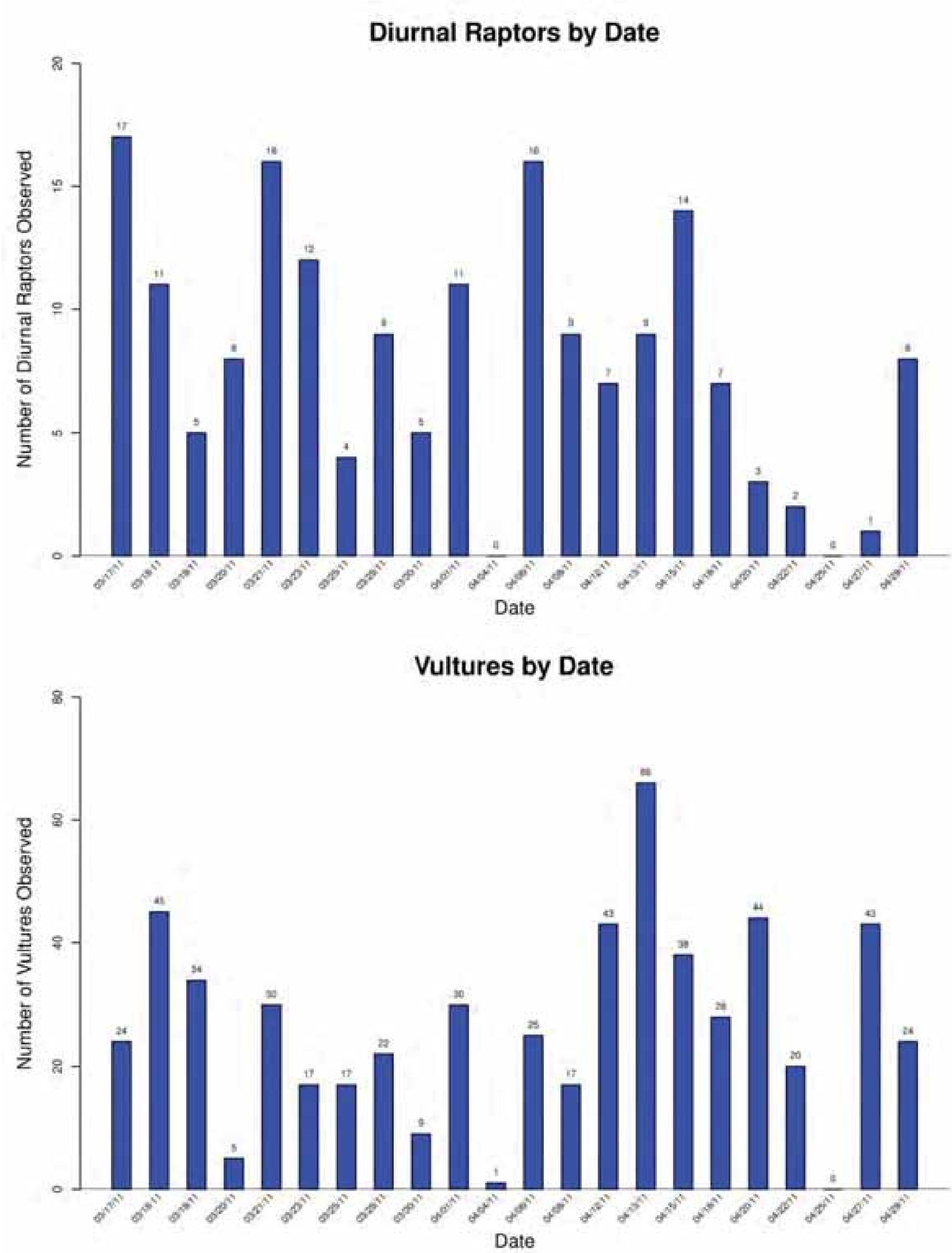

Figure 8. Total number of observations by survey day for raptors and vultures during the spring season raptor migration surveys at the Emerson Creek Wind Resource Area.

Flight Height Characteristics

To evaluate the relative risk of potential turbine collision to diurnal migrant birds, a rotor-swept height (RSH) of 20 to 120 meters AGL was used to estimate the approximate rotor-swept area, per ODNR guidelines (ODNR 2009). Overall, diurnal raptors observed flying in the RSH during 67.3% of observation (Table 5); however, several raptor subtypes were observed in the RSH more often than the overall mean (buteos [78.8%], eagles [76.3%], osprey [100%], and accipiters [68.2%; Table 5]).

Table 5. Flight height characteristics of major bird types and raptor subtypes observed during fall 2010 and spring 2011 raptor migration surveys at the Emerson Creek Wind Resource Area.

Bird Type / Subtypes	# of Grps.	# of Obs.	Mean Flight Ht. (ft)	% in Flight	% Within RSH
Waterbirds	12	19	37.08	90.5	84.2
Waterfowl	35	1,393	37.34	25.7	18
Shorebirds	69	192	14.52	98.5	37
Gulls/Terns	5	60	39.00	100	95
Diurnal Raptors	285	309	31.02	95.4	67.3
Accipiters	*21*	*22*	*31.00*	*100*	68.2
Buteos	*164*	*179*	*33.74*	*92.3*	78.8
Northern Harrier	*32*	*32*	*9.72*	*100*	15.6
Eagles	*37*	*38*	*37.49*	*100*	76.3
Falcons	*17*	*22*	*23.65*	*100*	27.3
Osprey	*1*	*1*	*60.00*	*100*	100
Other Raptors	*13*	*15*	*38.15*	*100*	73.3
Vultures	870	1,181	29.59	100	80.4
Upland Game Birds	2	8	0	20.0	0
Doves/Pigeons	25	43	11.72	100	39.5
Passerines	507	3,953	13.22	99.4	38.4
Swifts/Hummingbirds	19	28	19.05	100	35.7
Woodpeckers	6	7	15.67	100	57.1

RSH=likely rotor-swept heights for potential collision with a turbine blade or 20 to 120 m (65 to 394 ft) above ground level

Sensitive Species Observations

No federally-listed threatened or endangered species were observed during raptor migration surveys within the ECWRA. Two Ohio state-listed endangered species, northern harrier (32 observations) and sandhill crane (*Grus canadensis*; three observations) were observed during raptor migration surveys (Table 3). Additionally, three state-listed threatened species (bald eagle [38 observations], osprey [*Pandion haliaetus*; one observation], and peregrine falcon [*Falco peregrines*; one observation]) two species of special concern (sharp-shinned hawk [four observations] and great egret [two observations], and one state species of special interest (Wilson's snipe [*Gallinago delicate*; one observation]) were observed. The bald eagle is state-threatened and protected under the Bald and Golden Eagle Protection Act (BGEPA; Table 3).

Bald Eagle Fixed-Point Surveys

A total of 374 20-min bald eagle fixed-point surveys were conducted within ECWRA during 38 visits from September 9, 2010 to August 29, 2011. Surveys were broken down to two seasons: the breeding season (March 1 – August 31) and the winter (September 1 – February 15).

Bird Diversity and Species Richness

Seventy-nine unique bird species were observed during the bald eagle surveys representing 6,464 individual birds in 2,524 groups (Appendix C). Twenty-two bald eagles were observed during bald eagle fixed-point surveys, accounting for 9.8% of all raptor observations (Appendix C). Bald eagles were the only eagle species observed during surveys.

Eagle Use, Composition, and Frequency of Occurrence by Season

Of all bird types observed during surveys, eagles had an observed mean use of 0.07 birds/plot/20-minute survey during the breeding season and 0.04 birds/plot/20-minute survey during the winter (Table 6). Eagles comprised 1.2% of all birds observed during both seasons and were observed during 2.9% of surveys in the breeding season and 3.6% of surveys in the winter (Table 6).

Table 6. Mean bird use (number of birds/plot[a]/20-minute survey), percent of use (%), and frequency of occurrence (%) for each large and small bird type and raptor subtype by season during bald eagle surveys at the Emerson Creek Wind Resource Area from September 9, 2010, to August 29, 2011.

	Mean Use		% of Use		% Frequency	
Bird Type / Subtype	**Breeding Season**	**Winter**	**Breeding Season**	**Winter**	**Breeding Season**	**Winter**
Waterbirds	0.06	0.21	1.1	7.1	5.8	1.4
Waterfowl	0.21	0	3.9	0	4.6	0
Shorebirds	0.70	0.47	13.0	15.5	36.7	10.2
Gulls/Terns	0.03	0	0.5	0	2.1	0
Diurnal Raptors	0.59	0.48	10.9	16.0	37.9	34.4
Accipiters	*0.02*	*0.01*	*0.4*	*0.5*	*1.7*	*1.4*
Buteos	*0.36*	*0.24*	*6.6*	*7.9*	*27.5*	*18.7*
Northern Harrier	*0.03*	*0.08*	*0.5*	*2.6*	*2.9*	*7.1*
Eagles	*0.07*	*0.04*	*1.2*	*1.2*	*2.9*	*3.6*
Falcons	*0.09*	*0.07*	*1.6*	*2.4*	*7.1*	*5.7*
Osprey	*0*	*0.01*	*0*	*0.5*	*0*	*1.4*
Other Raptors	*0.03*	*0.03*	*0.5*	*1.0*	*2.9*	*2.9*
Vultures	2.33	1.09	43.2	36.2	66.2	40.3
Upland Game Birds	0.04	0.37	0.7	12.2	0.4	1.5
Doves/Pigeons	0.94	0.28	17.3	9.3	33.3	6.4
Large Corvids	0.50	0.11	9.3	3.6	29.2	5.8
Large Birds Overall	**5.40**	**3.00**	**100**	**100**		
Passerines	11.57	9.08	99.4	98.9	80.0	59.9
Swifts/Hummingbirds	0.03	0	0.3	0	1.2	0
Woodpeckers	0.04	0.10	0.3	1.1	2.9	4.3
Kingfishers	<0.01	0	<0.1	0	0.4	0
Small Birds Overall	**11.65**	**9.18**	**100**	**100**		

[a] 800-meter (m) radius for large birds and 100-m for small birds.

Flight Height Characteristics

To evaluate the relative risk of potential turbine collision to diurnal birds, specifically eagles, a RSH of 20 to 120 m AGL was used to estimate the approximate rotor-swept area of turbines, per ODNR guidelines (ODNR 2009). Eagles were observed flying within the RSH during 83.3% of observations (Table 17).

Table 7. Flight height characteristics by bird type[a] and raptor subtype during bald eagle surveys at the Emerson Creek Wind Resource Area from September 9, 2010, to August 29, 2011.

Bird Type / Subtype	# of Grps. Flying	# of Obs. Flying	Mean Flight Height (m)	% Obs. Flying	% within RSH
Waterbirds	16	44	24.94	77.3	77.3
Waterfowl	8	42	32.38	71.4	71.4
Shorebirds	104	220	6.18	9.1	7.7
Gulls/Terns	3	4	45.00	100	100
Diurnal Raptors	169	188	36.12	62.8	55.9
Accipiters	*7*	*7*	*24.29*	28.6	*28.6*
Buteos	*93*	*108*	*38.74*	73.1	*64.8*
Northern Harrier	*18*	*18*	*9.11*	16.7	*16.7*
Eagles	*18*	*18*	*57.39*	94.4	*83.3*
Falcons	*22*	*26*	*33.91*	38.5	*30.8*
Osprey	*2*	*2*	*42.50*	100	*100*
Other Raptors	*9*	*9*	*33.78*	55.6	*55.6*
Vultures	406	655	39.47	75.7	66.9
Upland Game Birds	2	51	0	0	0
Doves/Pigeons	106	251	7.81	6	6.0
Large Corvids	76	114	12.93	14.9	14.0
Large Birds Overall	**890**	**1,569**	**28.51**	**46.8**	**42.0**
Passerines	1,155	3,452	6.84	16.8	12.0
Swifts/Hummingbirds	2	2	3.50	0	0
Woodpeckers	10	11	9.30	0	0
Kingfishers	1	1	18.00	0	0
Small Birds Overall	**1,168**	**3,466**	**6.87**	**16.8**	**12.0**

[a.] 800-meter (m) radius plot for large birds and 100-m for small birds.

[b.] The likely "rotor-swept height" for potential collision with a turbine blade, or 20 to 120 meters(m; 66 to 394 feet [ft]) AGL.

Spatial Use

Bald eagles were observed at all points except B3, B6, B7 and B9 during surveys (Figure 9a). Bald eagle use was highest at points B1 (near the nest) and B4 (southwest of the nest) and use at these points was greater than 0.15 birds/20-minute survey. Eagle use at all other points was less than 0.11 birds/20-minute survey (Figure 9b).

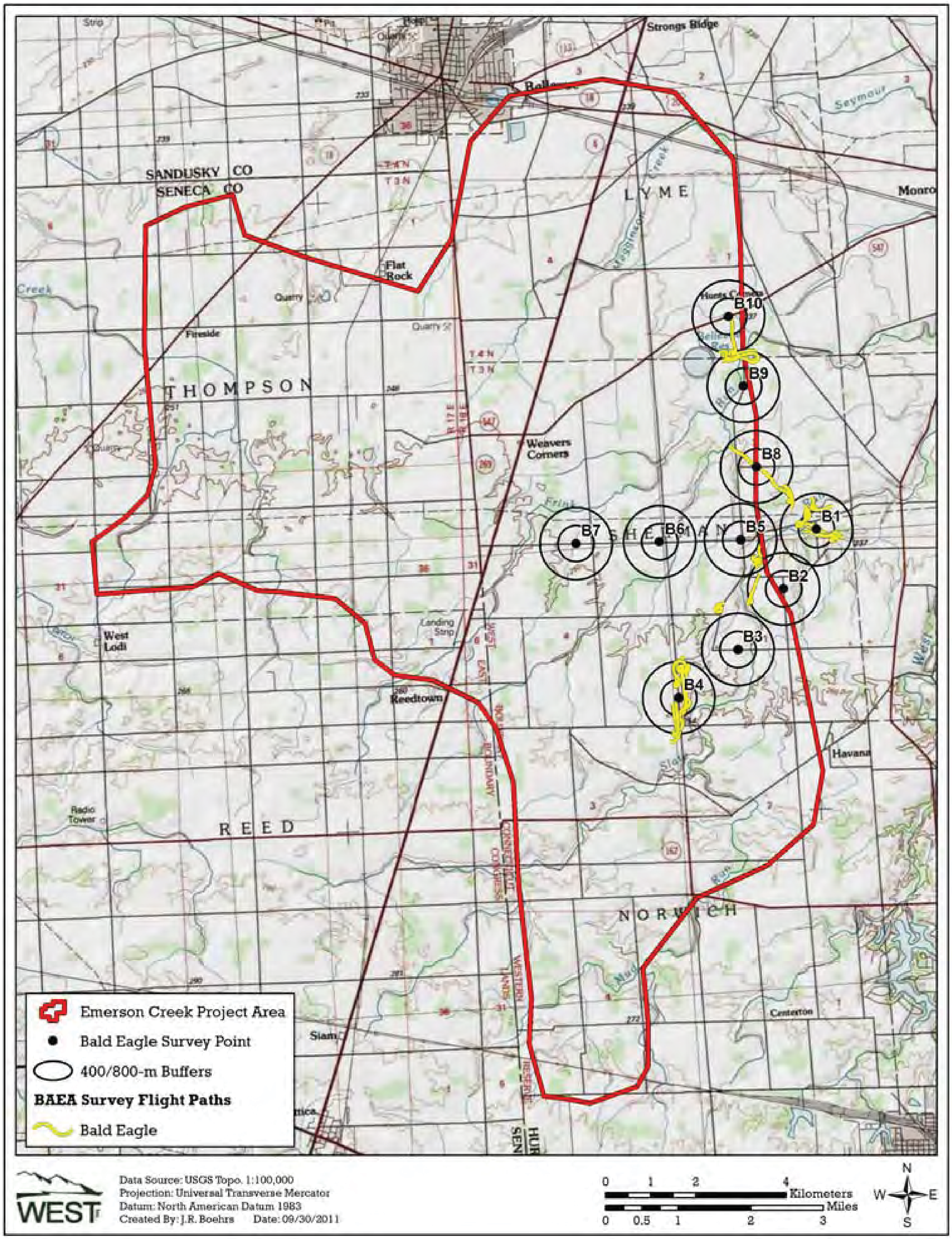

Figure 9a. Bald eagle flight paths during bald eagle surveys at the Emerson Creek Wind Resource Area.

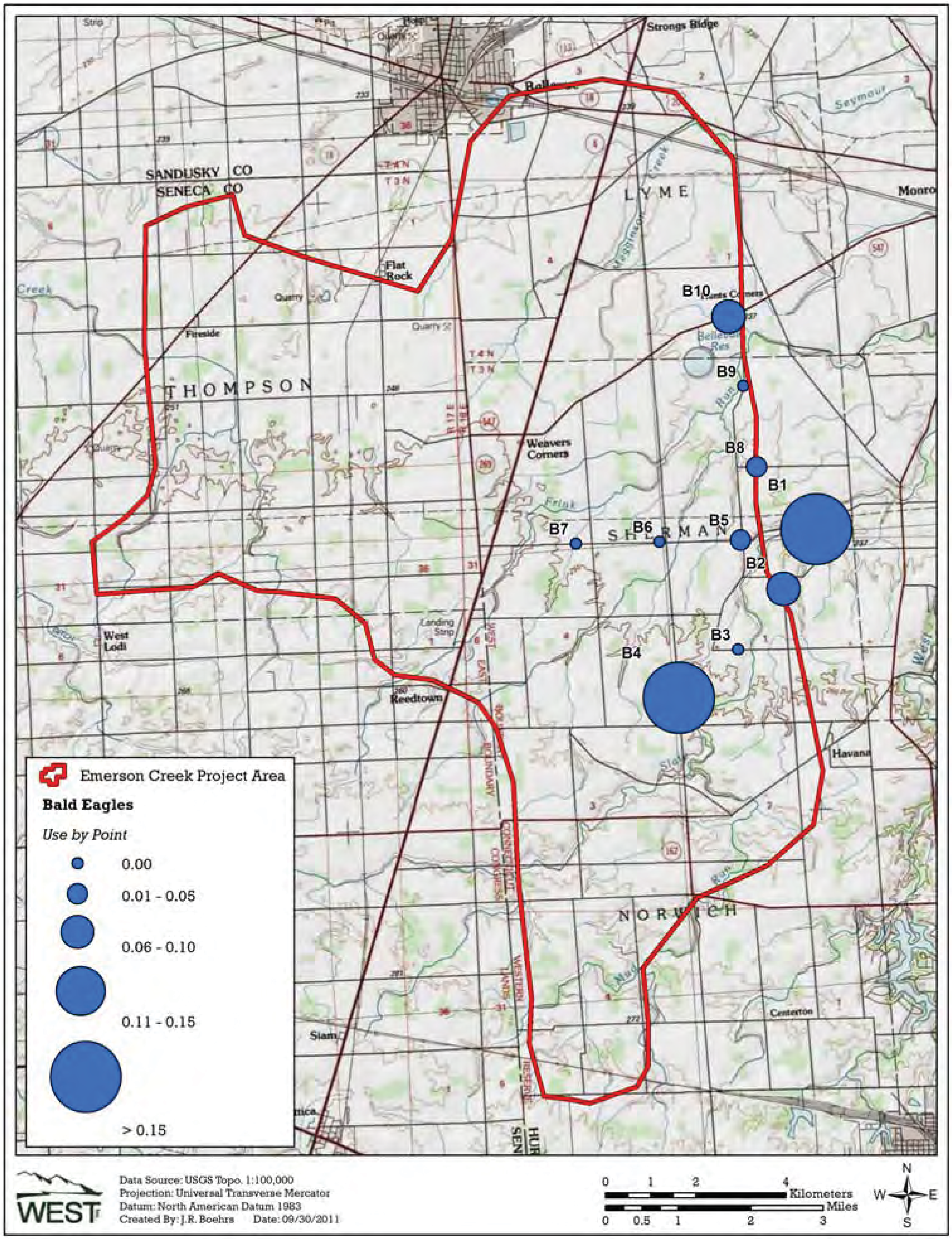

Figure 9b. Bald eagle use by point during the bald eagle surveys at the Emerson Creek Wind Resource Area.

Incidental Wildlife Observations

Thirty-seven bird species totaling 4,627 individuals within 283 separate groups were recorded incidentally at the ECWRA (Table 8). Sixteen species, ring-necked duck (*Aythya collaris*), American wigeon (*Anas americana*), pectoral sandpiper (*Calidris melanotos*), northern shoveler (*Anas clypeata*), green-winged teal (*Anas crecca*), ruddy duck (*Oxyura jamaicensis*), lesser yellowlegs (*Tringa flavipes*), blue-winged teal (*Anas discors*), hooded merganser (*Lophodytes cucullatus*), red-breasted merganser (*Mergus serrator*), American black duck (*Anas rubripes*), merlin (*Falco columbarius*), bufflehead (*Bucephala albeola*), green heron (*Butorides virescens*), red-throated loon (*Gavia stellata*) and snowy egret (*Egretta thula*), were only observed incidentally at the ECWRA. Four mammal species, white-tailed deer (*Odocoileus virginianus*), eastern cottontail (*Sylvilagus floridanus*), coyote (*Canis latrans*), and woodchuck (*Marmota monax*), were also recorded incidentally. Two state-listed endangered species (northern harrier and snowy egret), one threatened species (bald eagle), one species of special concern (great egret [*Ardea alba*]), and six species of special interest (American wigeon, northern pintail [*Anas acuta*], northern shoveler, green-winged teal, ruddy duck, and Wilson's snipe [*Gallinago delicate]*) were also recorded incidentally (Tables 3 and 8).

Table 8. Incidental wildlife observed while conducting all surveys at the Emerson Creek Wind Resource Area from September 1, 2010, to August 30, 2011.

Species	Scientific Name	# of Grps.	# of Obs.
mallard	*Anas platyrhynchos*	15	1,588
red-tailed hawk	*Buteo jamaicensis*	55	582
ring-necked duck	*Aythya collaris*	13	572
American wigeon	*Anas americana*	9	471
northern pintail	*Anas acuta*	7	447
unidentified duck		3	153
double-crested cormorant	*Phalacrocorax auritus*	1	125
northern harrier	*Circus cyaneus*	21	120
unidentified scaup		7	58
American kestrel	*Falco sparverius*	44	50
pectoral sandpiper	*Calidris melanotos*	1	50
dunlin	*Calidris alpina*	2	46
northern shoveler	*Anas clypeata*	6	41
green-winged teal	*Anas crecca*	5	39
unidentified waterfowl		1	38
tundra swan	*Cygnus columbianus*	6	35
Canada goose	*Branta canadensis*	6	29
bald eagle	*Haliaeetus leucocephalus*	24	28
wild turkey	*Meleagris gallopavo*	4	26
herring gull	*Larus argentatus*	3	14
greater yellowlegs	*Tringa melanoleuca*	5	13
ruddy duck	*Oxyura jamaicensis*	3	11
wood duck	*Aix sponsa*	3	10
turkey vulture	*Cathartes aura*	1	10
lesser yellowlegs	*Tringa flavipes*	4	8
great egret	*Ardea alba*	3	8
unidentified hawk		4	6
blue-winged teal	*Anas discors*	1	6
Cooper's hawk	*Accipiter cooperii*	5	5
hooded merganser	*Lophodytes cucullatus*	1	5

Table 8. Incidental wildlife observed while conducting all surveys at the Emerson Creek Wind Resource Area from September 1, 2010, to August 30, 2011.

Species	Scientific Name	# of Grps.	# of Obs.
unidentified swallow		1	5
eastern meadowlark	*Sturnella magna*	3	4
great blue heron	*Ardea herodias*	3	4
red-breasted merganser	*Mergus serrator*	2	4
American black duck	*Anas rubripes*	1	4
common merganser	*Mergus merganser*	2	3
merlin	*Falco columbarius*	2	2
Wilson's snipe	*Gallinago delicata*	2	2
bufflehead	*Bucephala albeola*	1	2
green heron	*Butorides virescens*	1	1
red-throated loon	*Gavia stellata*	1	1
snowy egret	*Egretta thula*	1	1
Bird Subtotal	**37 species**	**283**	**4,627**
white-tailed deer	*Odocoileus virginianus*	4	8
eastern cottontail	*Sylvilagus floridanus*	1	2
coyote	*Canis latrans*	1	1
woodchuck	*Marmota monax*	1	1
Mammal Subtotal	**4 species**	**7**	**12**

DISCUSSION

The primary purpose of conducting pre-construction wildlife surveys at proposed wind-energy facilities is to provide information for making reasonable estimates of potential impacts. The majority of the proposed ECWRA falls within the “minimum” and “moderate” survey intensity, as defined by the final ODNR wildlife guidelines (ODNR 2009). The eastern border of the ECWRA is classified as an “extensive” survey area due to the presence of a bald eagle nest. The methods used to collect information on bird and bat populations at the ECWRA fulfilled a portion of the methods recommended in final ODNR guidelines (ODNR 2009). Breeding bird surveys and bat mist-netting surveys have also been recommended by the ODNR and have not been completed, to date.

The ODNR guidelines provide a framework for establishing relatively consistent methods to be used at wind-energy facilities in Ohio, which will allow results to be compared between facilities within Ohio. Currently, the results from three pre-construction wildlife surveys are available for comparison from Ohio, and no data are available describing measured impacts to wildlife populations from post-construction studies at wind-energy facilities in Ohio. However, the impacts of wind-energy facilities to wildlife have been studied at several facilities across the US. Thus, our estimates of potential impacts to wildlife are based on studies of wind-energy facilities conducted throughout the US, with a focus on studies located within agricultural regions of the Midwest

Potential Impacts

Impacts to wildlife resources from wind energy facilities can be direct or indirect. Direct impacts include the potential for fatalities from construction and operation of the proposed wind energy facility. Indirect impacts include the potential to displace, wildlife during construction of or during the operational period of a wind energy facility, with the displacement either temporary or permanent.

Direct Effects

Regional Bird Data

Based on similar studies conducted at more recently constructed wind energy facilities, overall bird mortality in the Midwest is generally moderate compared to other facilities in North America (Table 9; Appendix E). The Midwestern facility with the highest mortality rate for all bird species combined is the Wessington Springs facility in South Dakota, with an estimated fatality rate of 8.25 birds per megawatt (MW) per study period (Derby et al. 2010f), followed by the Blue Sky Green Field facility in Wisconsin, with an estimated mortality rate of 7.17 birds/MW/study period (Gruver et al. 2009; Table 9). At the lower end, two years of studies were conducted at the Top of Iowa facility, with an estimate of 0.42 birds/MW/study period in 2003 and 0.81 birds/MW/study period in 2004 (Jain 2005). Another study at the low end, the Grand Ridge facility in Illinois, reported 0.48 birds/MW/study period (Derby et al. 2010g; Table 9). Various studies were conducted at multiple phases of the Buffalo Ridge facility in Minnesota, and accounted for a third of the publically available fatality studies in the Midwest. Fatality estimates at the Buffalo Ridge Facility ranged from 1.43birds/MW/study period (Phase I, 1999) to 5.93 birds/MW/study period (Phase III, 1999; Johnson et al. 2000a; Table 9).

Wind energy facility related bird fatalities comprise less than 0.1% of all known anthropogenic sources of bird fatalities (NRC 2007) and wind energy facility related bird fatalities are unlikely to affect current population trends of most North American songbirds (NWCC 2010).

Table 9. Wind energy facilities in Midwestern North America with fatality data for all bird species.

Wind Energy Facility	Fatality Estimate[A]	No. of Turbines	Total MW
Midwest			
Wessington Springs, SD	8.25	34	51
Blue Sky Green Field, WI	7.17	88	145
Cedar Ridge, WI	6.55	41	68
Buffalo Ridge, MN (Phase III; 1999)	5.93	138	103.5
Moraine II, MN	5.59	33	49.5
Buffalo Ridge I, SD	5.06	24	50.4
Buffalo Ridge, MN (Phase I; 1996)	4.14	73	25
Winnebago, IA	3.88	10	20
Buffalo Ridge, MN (Phase II; 1999)	3.57	143	107.25
Buffalo Ridge, MN (Phase I; 1998)	3.14	73	25
Ripley, Ont.	3.09	38	76
Buffalo Ridge, MN (Phase I; 1997)	2.51	73	25
Buffalo Ridge, MN (Phase II; 1998)	2.47	143	107.25
Kewaunee County, WI	1.95	31	20
NPPD Ainsworth, NE	1.63	36	59.4
Elm Creek, MN	1.55	67	100
Prairie Winds (Minot), ND	1.48	80	115.5
Buffalo Ridge, MN (Phase I; 1999)	1.43	73	25
Top of Iowa, IA (2004)	0.81	89	80
Grand Ridge, IL (Phase I; 2009)	0.48	66	99
Top of Iowa, IA (2003)	0.42	89	80

Table 9. Wind energy facilities in Midwestern North America with fatality data for all bird species.

Wind Energy Facility	Fatality Estimate[A]	No. of Turbines	Total MW

A=number of bird fatalities/MW/year
Data from the following sources:

Facility	Fatality Estimate	Facility	Fatality Estimate
Wessington Springs, SD	Derby et al. 2010f	Ripley, Ont.	Jacques Whitford 2009
Blue Sky Green Field, WI	Gruver et al. 2009	Buffalo Ridge, MN (Phase I; 97)	Johnson et al. 2000a
Cedar Ridge, WI	BHE Environmental 2010	Buffalo Ridge, MN (Phase II; 98)	Johnson et al. 2000a
Buffalo Ridge, MN (Phase III; 99)	Johnson et al. 2000a	Kewaunee County, WI	Howe et al. 2002
Moraine II, MN	Derby et al. 2010d	NPPD Ainsworth, NE	Derby et al. 2007
Buffalo Ridge I, SD	Derby et al. 2010b	Elm Creek, MN	Derby et al. 2010c
Buffalo Ridge, MN (Phase I; 96)	Johnson et al. 2000a	Prairie Winds (Minot), ND	Derby et al. 2011
Winnebago, IA	Derby et al. 2010e	Buffalo Ridge, MN (Phase I; 99)	Johnson et al. 2000a
Buffalo Ridge, MN (Phase II; 99)	Johnson et al. 2000a	Top of Iowa, IA (04)	Jain 2005
Buffalo Ridge, MN (Phase I; 98)	Johnson et al. 2000a	Grand Ridge, IL	Derby et al. 2010g
		Top of Iowa, IA (03)	Jain 2005

Raptor Use and Exposure Risk

Data from the ECWRA raptor migration surveys was compared to data collected (number of raptor observations and bald eagle observations per observer hour, excluding vultures) at Hawk Migration Association of North America (HMANA) Hawkwatch sites within the same region as the ECWRA (Tables 10 and 11). The average number of raptors and bald eagles per observer hour at the ECWRA was lower than the averages seen at other sites in Pennsylvania, Michigan and Ontario, Canada (Tables 10 and 11). Based on the data collected during raptor migration surveys within the ECWRA, raptor migration rates are lower than recorded at the nearest Hawkwatch sites.

Table 10. Monthly and seasonal raptor data (number of raptor observations per observer hour) for the Emerson Creek compared to nearby Hawkwatch sites[A].

Month/ Season	Emerson Creek	Presque Isle, PA	Holiday Beach CA, Ont.	Hawk Cliff, Ont.	Lake Erie Metro Park, MI
		Hawkwatch Site			
September 2010	0.96	-no data-	76.53	397.75	323.63
October 2010	0.73	-no data-	24.30	41.93	17.83
March 2011	1.79	7.14	-no data-	-no data-	-no data-
April 2011	0.93	42.37	-no data-	-no data-	-no data-
Fall 2010	0.85		49.99	216.83	168.05
Spring 2011	1.28	25.13	-no data-	-no data-	-no data-

A= obtained from www.hmana.org (HMANA 2011)

Table 11. Monthly and seasonal bald eagle data (number of bald eagle observations per observer hour) for the Emerson Creek compared to nearby Hawkwatch sitesA.

Month/ Season	Emerson Creek	Presque Isle, PA	Holiday Beach CA, Ont.	Hawk Cliff, Ont.	Lake Erie Metro Park, MI
		Hawkwatch Site			
September 2010	0.10	-no data-	0.37	0.59	0.63
October 2010	0.05	-no data-	0.21	0.38	0.28
March 2011	0.18	0.29	-no data-	-no data-	-no data-

Table 11. Monthly and seasonal bald eagle data (number of bald eagle observations per observer hour) for the Emerson Creek compared to nearby Hawkwatch sitesA.

Month/ Season	Emerson Creek	Presque Isle, PA	Holiday Beach CA, Ont.	Hawk Cliff, Ont.	Lake Erie Metro Park, MI
		Hawkwatch Site			
April 2011	0.16	0.37	-no data-	-no data-	-no data-
Fall 2010	0.07	-no data-	0.29	0.49	0.46
Spring 2011	0.10	0.33	-no data-	-no data-	-no data-

A= obtained from www.hmana.org (HMANA 2011)

Raptor migration levels (number of raptor observations per observer hour, excluding vultures) collected during the fall of 2010 and spring of 2011 at the ECWRA was also lower than raptor migration levels observed during the spring of 2009 at the Black Swamp Bird Observatory (BSBO) located in Ohio along the southwest shore of Lake Erie (Shieldcastle 2010). Surveys at the BSBO occurred between February 28 and May 9, 2009 with 4.15 raptors observed per hour (excluding vultures). Bald eagle migration rates were also higher at the BSBO during the spring of 2009 (0.27 eagles/observer hour) compared to the fall 2010 and spring 2011 migration levels at the ECWRA (0.07 and 0.10 eagles/observer hour, respectively; Table 11)

Annual mean diurnal raptor use (number of raptors divided by the number of plots and the total number of surveys) at the ECWRA was compared with studies at other wind energy facilities that implemented similar protocols and had data for the fall and spring, with most facilities located in the western US. The mean raptor use at these wind energy facilities ranged from 0.10 to 3.18 raptors/plot/20-min survey during the fall and 0.03 to 1.65 raptors/plot/20-min survey during the spring (Figures 10 and 11). A ranking of seasonal raptor mean use was developed based on the results from those wind energy facilities: low (0 – 0.5 raptors/plot/20-min survey), low to moderate (0.5 – 1.0), moderate (1.0 – 2.0), high (2.0 – 3.0), and very high (more than 3.0). Under this ranking, mean raptor use at the ECWRA during the fall and spring (0.23 and 0.34 raptors/plot/20-min survey, respectively) is considered to be low; ranking thirty-fifth compared to the 43 other wind energy facilities in the fall and thirty-seventh compared to the other 51 facilities in the spring (Figures 10 and 11).

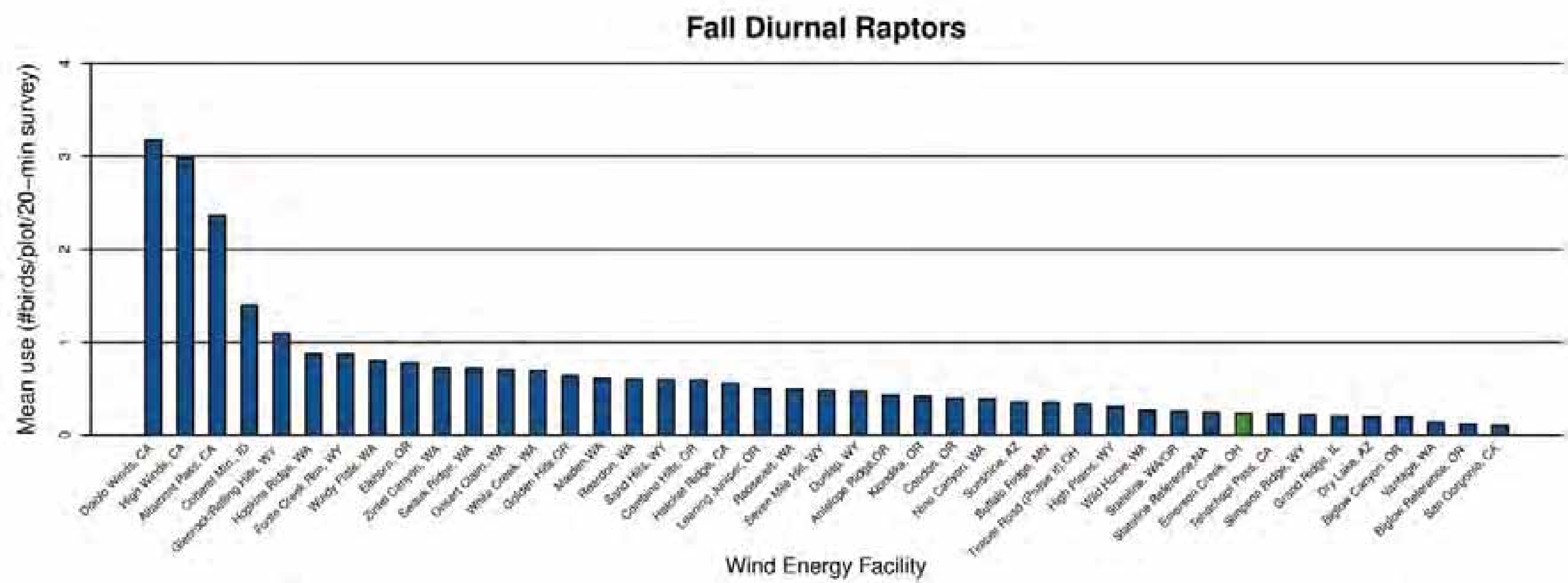

Figure 10. Comparison of fall raptor use between the Emerson Creek Wind Resource Area and other US wind energy facilities.
Data from the following sources:

Study and Location	Reference	Study and Location	Reference	Study and Location	Reference
Emerson Creek, OH	This study.				
Diablo Winds, CA	WEST 2006	Maiden, WA	Young et al. 2002	Buffalo Ridge, MN	Johnson et al. 2000a
High Winds, CA	Kerlinger et al. 2005	Reardon, WA	WEST 2005b	Timber Road (Phase II), OH	Good et al. 2010
Altamont Pass, CA	Orloff and Flannery 1992	Sand Hills, WY	Johnson et al. 2006a	High Plains, WY	Johnson et al. 2009b
Cotterel Mtn., ID	BLM 2006	Combine Hills, OR	Young et al. 2003d	Wild Horse, WA	Erickson et al. 2003d
Glenrock/Rolling Hills, WY	Johnson et al. 2008a	Hatchet Ridge, CA	Young et al. 2007b	Stateline, WA/OR	Erickson et al. 2002b
Hopkin's Ridge, WA	Young et al. 2003a	Leaning Juniper, OR	Kronner et al. 2005	Stateline Reference	URS et al. 2001
Foote Creek Rim, WY	Johnson et al. 2000b	Roosevelt, WA	NWC and WEST 2004	Tehachapi Pass, CA	Anderson et al. 2000
Windy Flats, WA	Johnson et al. 2007	Seven Mile Hill, WY	Johnson et al. 2008b	Simpson Ridge, WY	Johnson et al. 2000b
Elkhorn, OR	WEST 2005a	Dunlap, WY	Johnson et al. 2009a	Grand Ridge, IL	Derby et al. 2009
Zintel Canyon, WA	Erickson et al. 2002a, 2003c	Antelope Ridge, OR	WEST 2009	Dry Lake, AZ	Young et al. 2007c
Swauk Ridge, WA	Erickson et al. 2003b	Klondike, OR	Johnson et al. 2002a	Biglow Canyon, OR	WEST 2005d
Desert Claim, WA	Young et al. 2003b	Condon, OR	Erickson et al. 2002b	Vantage, WA	WEST 2007
White Creek, WA	NWC and WEST 2005	Nine Canyon, WA	Erickson et al. 2001b	Biglow Reference, OR	WEST 2005d
Golden Hills, OR	Jeffrey et al. 2008	Sunshine, AZ	WEST and CPRS 2006	San Gorgonio, CA	Anderson et al. 2000
Emerson Creek, OH	This study.				

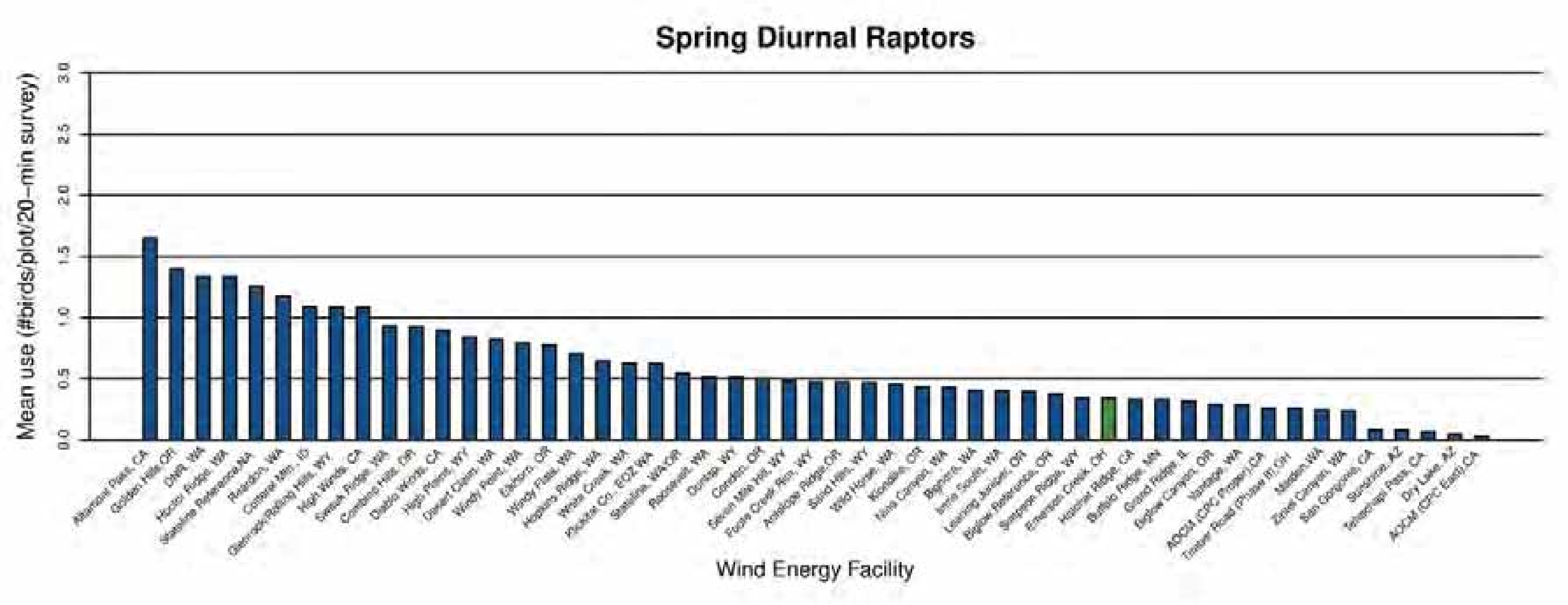

Figure 11. Comparison of spring raptor use between the Emerson Creek Wind Resource Area and other US wind energy facilities.
Data from the following sources:

Study and Location	Reference	Study and Location	Reference	Study and Location	Reference
Emerson Creek, OH	This study.				
Altamont Pass, CA	Orloff and Flannery 1992	Hopkin's Ridge, WA	Young et al. 2003a	Biglow Reference, OR	WEST 2005d
Golden Hills, OR	Jeffrey et al. 2008	White Creek, WA	NWC and WEST 2005	Simpson Ridge, WY	Johnson et al. 2000b
DNR, WA	Johnson et al. 2006c	Klickitat Co., EOZ WA	WEST and NWC 2003	Hatchet Ridge, CA	Young et al. 2007b
Hoctor Ridge, WA	Johnson et al. 2006d	Stateline, WA/OR	Erickson et al. 2003a	Buffalo Ridge, MN	Johnson et al. 2000a
Stateline Reference	URS et al. 2001	Roosevelt, WA	NWC and WEST 2004	Grand Ridge, IL	Derby et al. 2009
Reardon, WA	WEST 2005b	Dunlap, WY	Johnson et al. 2009a	Biglow Canyon, OR	WEST 2005d
Cotterel Mtn., ID	BLM 2006	Condon, OR	Erickson et al. 2002b	Vantage, WA	WEST 2007
Glenrock/Rolling Hills, WY	Johnson et al. 2008a	Seven Mile Hill, WY	Johnson et al. 2008b	AOCM (CPC Proper), CA	Chatfield et al. 2010a
High Winds, CA	Kerlinger et al. 2005	Foote Creek Rim, WY	Johnson et al. 2000b	Timber Road (Phase II), OH	Good et al. 2010
Swauk Ridge, WA	Erickson et al. 2003b	Antelope Ridge, OR	WEST 2009	Maiden, WA	Young et al. 2002
Combine Hills, OR	Young et al. 2003d	Sand Hills, WY	Johnson et al. 2006a	Zintel Canyon, WA	Erickson et al. 2002a, 2003c
Diablo Winds, CA	WEST 2006	Wild Horse, WA	Erickson et al. 2003d	San Gorgonio, CA	Anderson et al. 2000
High Plains, WY	Johnson et al. 2009b	Klondike, OR	Johnson et al. 2002a	Sunshine, AZ	WEST and the CPRS 2006
Desert Claim, WA	Young et al. 2003b	Nine Canyon, WA	Erickson et al. 2001b	Tehachapi Pass, CA	Andersonet al. 2000
Windy Point, WA	Johnson et al. 2006b	Bighorn, WA	Johnson and Erickson 2004	Dry Lake, AZ	Young et al. 2007c

There are currently few post-construction bird mortality studies with corresponding pre-construction data in the Midwest (Table 12). Raptor use at the proposed ECWRA (0.28 raptors/plot/20-min survey for the spring and fall combined) was slightly higher than overall raptor use reported from the Grand Ridge facility in Illinois (0.20 raptors/plot/20-min survey; Derby et al. 2009) and the Wessington Springs facility in South Dakota (0.23 raptors/plot/20-min survey; Derby et al. 2008; Table 12).

Table 12. Comparison of raptor use estimates and raptor fatality rates at wind energy facilities in the Midwest and the Emerson Creek Wind Resource Area.

Wind Energy Facility	Use Estimate[A]	Raptor Fatality Rate[B]	No. of Turbines	Total MW
Emerson Creek, OH	**0.28**			
	Midwest			
Buffalo Ridge, MN (Phase I; 1996)		0.47	73	25
Moraine II, MN		0.37	33	49.5
Winnebago, IA		0.27	10	20
Buffalo Ridge I, SD (2010)		0.2	24	50.4
NPPD Ainsworth, NE		0.06	36	20.5
Prairie Winds (Minot), ND		0.05	80	115.5
Kewaunee County, WI		0	31	20.46
Wessington Springs, SD	0.23	0	34	51
Grand Ridge, IL	0.20	0	66	99
Elm Creek, MN		0	67	100
Blue Sky Green Field, WI		0	88	145

A = number of raptors/plot/20-min survey
B = number of fatalities/MW/study period
Data from the following sources:

Wind-Energy Facility	Use Estimate	Fatality Estimate	Wind-Energy Facility	Use Estimate	Fatality Estimate
Buffalo Ridge, MN (Phase I; 1996)		Johnson et al. 2000a	Prairie Winds (Minot), ND		Derby et al. 2011
Moraine II, MN		Derby et al. 2010d	Kewaunee County, WI		Howe et al. 2002
Winnebago, IA		Derby et al. 2010e	Wessington Springs, SD	Derby et al. 2008	Derby et al. 2010f
Buffalo Ridge I, SD (2010)		Derby et al. 2010b	Grand Ridge, IL	Derby et al. 2009	Derby et al. 2010g
NPPD Ainsworth, NE		Derby et al. 2007	Elm Creek, MN		Derby et al. 2010c
			Blue Sky Green Field, WI		Gruver et al. 2009

Currently, only three wind energy facilities in Ohio have publically-available pre-construction data. Mean raptor use at the ECWRA during the spring (0.34 raptors/plot/20-min survey) and fall (0.23 raptors/plot/20-min survey) was similar to the three other wind energy facilities in Ohio (Table 13).

Table 13. Comparison of seasonal raptor use at other wind-energy facilities in Ohio to the Emerson Creek Wind Resource Area.

	Raptor Use (# raptors/20-min survey)				
Site	**Fall**	**Winter**	**Spring**	**Summer**	**Reference**
Emerson Creek, OH	0.23	-	0.34	-	This study
Black Fork, OH	0.13	-	0.26	-	Ecology and Environment 2009
Buckeye Wind, OH	0.11	-	0.20	-	Stantec 2009c
Timber Road II, OH	0.33	0.32	0.26	0.42	Good et al. 2010

To date, relatively few raptor fatalities have been reported at wind energy facilities in the Midwest that are located within similar landscapes as the ECWRA. A total of 28 diurnal raptors

(5.7% of all recorded fatalities) were recorded as fatalities at studies of 17 existing wind energy facilities in the Midwest, including Iowa, Wisconsin, Minnesota, Nebraska, South Dakota, North Dakota, Iowa, Illinois, and portions of Ontario, Canada (BHE Environmental 2010, 2011; Derby et al. 2007, 2010a, 2010b, 2010c, 2010d, 2010e, 2010f, 2010g, 2011; Golder Associates 2010; Grodsky and Drake 2011; Gruver et al. 2009; Howe et al. 2002; Jacques Whitford 2009; Jain 2005; Johnson et al. 2000; Kerlinger et al. 2007). The raptor fatality rate at the ECWRA is expected to be similar to those observed at other Midwestern wind energy facilities with similarly collected data (Table 11).

Passerine Use and Exposure Risk

Passerines

Passerines have been the most abundant bird fatality at wind energy facilities outside California (Erickson et al. 2001a, 2002b), often comprising more than 80% of bird fatalities. Many passerine species migrate at night and at heights greater than observed during this study (see USFWS 1998, Young et al. 2004), but migrants still have some risk of collision with turbines. Large numbers of songbirds have collided with lighted communication towers and buildings when foggy conditions and spring or fall migration coincide. Most collisions at communication towers are attributed to the guy wires on these structures, which modern wind turbines do not have. No large mortality events associated with turbine fatalities have been documented at wind energy facilities in North America on the same scale as those mortality events observed at communication towers (NWCC 2010). However, two notable mortality events where large numbers of birds were killed have recently been documented at wind energy facilities in West Virginia and have been attributed to lighting (American Bird Conservancy 2011).

Passerines may be more vulnerable to turbine collisions when ascending or descending from stopover habitats (grasslands and small woodlots) during migration, especially if turbines are placed near forest or grassland areas. Typically, small forest fragments in areas dominated by agriculture are not considered high-quality nesting habitat for passerines due to the fragment size and the abundance of edge habitat, which is associated with higher incidence of nest predation and parasitism (Askins et al. 1987, Robinson et al. 1995, Brawn and Robinson 1996). However, the size of individual forest fragments has not been identified as a significant factor in distinguishing passerine stopover habitat during migration (Bonter et al. 2009) and in the agricultural Midwest, even small forest fragments receive higher levels of use during migration as stopover habitat (Packett and Dunning 2009). Forested and grassland areas compose 8.6% of the total ECWRA and these areas likely receive higher levels of use by passerines stopping over during migration than the tilled agriculture areas. Migrating passerines and other species may be more at risk of turbine collision when ascending and descending from these stopover habitats.

Data collected to date at the ECWRA show that some passerines utilize the proposed wind-energy facility as stopover habitat. The lack of post-construction studies of wind-energy facilities in Ohio makes it difficult to utilize the data collected at the ECWRA to predict potential impacts to migrating passerines. The proposed facility is located within a landscape largely dominated by tilled agriculture, which is generally recommended by the USFWS as more suitable for wind development versus areas containing native habitats (USFWS 2003). The efficacy of passerine migration and breeding bird counts as predictors of potential bird fatality rates will be better understood after more research is conducted at wind-energy facilities in Ohio.

Indirect Effects

The studies conducted at the ECWRA were designed to examine potential direct impacts of the operation of the ECWRA. However; the indirect impacts of wind energy facilities has also been raised as a general concern by the USFWS for wind energy facilities across the US. In particular, the UFSWS (2003) has expressed concern over the potential of wind turbines located in grassland habitats to displace grassland birds. Habitats documented in the ECWRA that may be utilized by grassland and passerine birds for nesting (grasslands and pasture/hay) are not abundant in the ECWRA and compose approximately 509.6 acres (1.1%) of the total area. Turbines placed within tilled agriculture should have a relatively low potential to displace nesting grassland birds, but turbines placed within grassland habitats may have greater potential to reduce breeding grassland bird densities.

Sensitive Species

No federally-listed threatened or endangered species were observed during surveys within the ECWRA. Twenty-seven state-listed endangered (five species), threatened (six species), species of special concern (four species) or species of special interest (12 species) were observed during surveys (Table 4).

A total of 172 northern harriers were observed during all surveys at the ECWRA. Although the northern harrier is listed as a state endangered species in Ohio (ODNR 2009), northern harriers are fairly common in Ohio and the Midwest during the spring and fall migrations, and also during the winter. Northern harriers were observed during all survey types conducted in the ECWRA. Observations of northern harrier in the ECWRA likely represent individuals migrating through or wintering in the area as most observations were made during the spring and fall migration season and winter. Northern harriers require large undisturbed wetlands, pastures, old fields, marshes, and upland habitats for breeding (Peterjohn 2001), and there is some potential for northern harriers to nest within the ECWRA. However, no northern harrier nests were observed during raptor nest surveys and breeding pairs of northern harriers are currently considered rare in northwest and central Ohio. There is one possible record of breeding northern harriers in Seneca County (OBBA 2009).

The number of northern harriers reported during the surveys may not represent 172 separate individuals; rather, a portion of these likely represents repeated observations of the same individuals. Of the observations of flying northern harriers during the raptor migration surveys and bald eagle surveys, less than 17% were observed in the likely RSH (15.6% and 16.7%, respectively). The hunting habits of northern harriers typically involve low, coursing flights over grassland habitats (Macwhirter and Bildstein 1996), which likely decreases the potential for this species to collide with a wind turbine. Northern harriers may fly higher and within the potential RSH when conducting aerial courtship displays, and this species may occasionally fly within the RSH during migration. However, the data collected at the ECWRA and other wind-energy facilities (Johnson et al. 2000a, Kerlinger 2002a, Smallwood et al. 2009) indicates that northern harriers spend the majority of their time flying below blade height. Northern harriers have been documented as fatalities at other wind energy facilities (Erickson et al. 2001a, Smallwood and Karas 2009, Stantec Ltd. 2011), and the potential exists for northern harriers to be found as fatalities at the ECWRA, particularly during migration. The overall level of northern harrier fatalities is relatively low when compared to the relative abundance of this species at other wind energy facilities (Erickson et al. 2001a).

The bald eagle is federally protected under the Migratory Bird Treaty Act (MBTA 1918), the BGEPA (1940), and is listed as threatened under the Ohio endangered species act (ODNR 2009). The USFWS has also produced a Draft Eagle Conservation Plan Guidance, which provides recommendations to avoid, minimize, and mitigate adverse effects to bald eagles and golden eagles *(USFWS 2011b*). A population of nesting bald eagles is present along the southern shore of Lake Erie and bald eagles have fairly well-defined migrations along Lake Erie in the spring and fall (Peterjohn 2001). A bald eagle nest was also reported by the ODNR along Slate Run, a tributary of the Huron River, located on the eastern border of the ECWRA. During the raptor nest surveys, raptor migration surveys and bald eagle surveys, the nest was observed to be inactive; however, several observations (88) of bald eagles were made during surveys in the ECWRA. Of the bald eagles observed flying during raptor migration surveys and bald eagle surveys 76.3% and 94.4% were observed flying within the RSH, respectively. Bald eagles may fly at the same heights of turbine blades, and some potential of collision does exist for this species.

Several species of sensitive waterfowl and waterbirds were observed during raptor migration surveys, bald eagle surveys, and incidentally within the ECWRA including, American wigeon (471 observations), northern pintail (448), northern shoveler (41), green-winged teal (39), great egret (17), and ruddy duck (11; Table 4). All of these species require large undisturbed wetlands or marshes for breeding habitat (Peterjohn 2001), which are largely lacking from the ECWRA. All observations of sensitive waterfowl and waterbirds were made in the early spring during March and April and likely represent individuals migrating through the area and there is limited potential that these species breed wtihin the ECWRA. Waterfowl and waterbirds are currently rarely reported as fatalities from US wind-energy facilities (1% and 2% of bird carcasses, respectively; NRC 2007), and impacts to these species are expected to be low..At 17 studies in the Midwest, waterbird and waterfowl species have only composed 0.2% and 7.6% of fatalities, respectively (BHE Environmental 2010, 2011; Derby et al. 2007, 2010a, 2010b, 2010c, 2010d, 2010e, 2010f, 2010g, 2011; Golder Associates 2010; Grodsky and Drake 2011; Gruver et al. 2009; Howe et al. 2002; Jacques Whitford 2009; Jain 2005; Johnson et al. 2000; Kerlinger et al. 2007).

Ten bobolinks, a state species of concern (ODNR 2009), were observed during the bald eagle surveys within the ECWRA and all observations were made during May and June. There are several probable breeding records of bobolinks in Huron and Seneca Counties (OBBA 2009), and this species requires large grassy fields or large hayfields for breeding habitat. The majority of the ECWRA does not contain suitable nesting habitat for bobolinks. However, there is some potential for bobolinks to breed within the ECWRA, as evidenced by observations of this species during the breeding season.

Several state threatened dark-eyed juncos (86 individuals; ODNR 2009) and state species of special interest golden-crowned kinglets (54; ODNR 2009) were observed within the ECWRA during surveys. No breeding records for either species exist for Huron or Seneca Counties (OBBA 2009). The dark-eyed junco requires forests with dense shrub layers and ground cover for breeding, while golden-crowned kinglet utilizes spruce (*Picea* spp.), pine plantations, and hemlock forests, which are habitats that are largely lacking in the ECWRA. The majority of observations of dark-eyed juncos and all observations of golden-crowed kinglets occurred during the spring and fall, and likely represent individuals migrating through the study area.

Observations of other sensitive species (ODNR 2009; Table 3) were recorded within the ECWRA during periods corresponding with spring and fall migration or winter, including: American golden-plover (34 individuals), magnolia warbler (11), brown creeper (9), hermit thrush (8), sharp-shinned hawk (7), Henslow's sparrow (5), yellow-bellied sapsucker (4), Wilson's snipe (3), lark sparrow (3), osprey (3), sandhill crane (3), Canada warbler (2), snowy egret (1), black-throated blue warbler (1), least flycatcher (1), peregrine falcon (1), and red-breasted nuthatch (1). None of these species have confirmed breeding records for either Huron or Seneca Counties (OBBA 209) and our data suggest that these species were not abundant within the study area and that observations are likely of migrants.

CONCLUSIONS AND RECOMMENDATIONS

The USFWS interim guidelines for wind energy development (USFWS 2003) suggest that wind energy facilities should be sited within previously altered habitats, and the proposed wind energy facility is located within an area dominated by tilled agriculture (84.1%). Areas within the ECWRA have potential to support populations of state and federally listed species and these landcover types include deciduous, mixed and evergreen forests, pasture/hay, grasslands, and woody and emergent wetlands. To the extent possible, turbines and associated infrastructure should be placed within tilled agriculture, and impacts to grasslands, woodlots, and wetlands should be reduced.

The results of the raptor migration surveys within the ECWRA show that raptor use rates were low compared to observations at other wind energy facilities across the U.S., and within the range of raptor use rates observed within the Midwest. Raptor fatality rates are expected to be similar to what has been observed in the Midwest.

Twenty-seven species listed as state or federally sensitive were observed at the ECWRA during all surveys. Additional sensitive species may occur and nest in the project area during the summer. Suitable habitat exists within the ECWRA for some of the observed sensitive species, and there is some potential for these species to nest within the ECWRA. Breeding bird surveys are recommended to help determine potential impacts to breeding bird species.

Bald eagles were observed utilizing areas near the ODNR documented nest as well as areas throughout the ECWRA. APEX should coordinate with the USFWS and ODNR regarding impacts to bald eagles.

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Appendix A: All bird types and species observed at the Emerson Creek Wind Resource Area during the passerine migration surveys from September 1, 2010, to August 30, 2011.

Appendix A. Summary of individuals (obs) and groups observations (grps) by bird type and species for passerine migration surveys at the Emerson Creek Wind Resource Area from September 1, 2010, to August 30, 2011.

		Fall		Spring		Overall	
Bird Type / Species	Scientific Name	# of Grps.	# of Obs.	# of Grps.	# of Obs.	# of Grps.	# of Obs.
Waterbirds		**5**	**70**	**5**	**5**	**10**	**75**
double-crested cormorant	*Phalacrocorax auritus*	3	67	0	0	3	67
great blue heron	*Ardea herodias*	2	3	4	4	6	7
great egret	*Ardea alba*	0	0	1	1	1	1
Waterfowl		**9**	**97**	**13**	**25**	**22**	**122**
Canada goose	*Branta canadensis*	6	85	5	7	11	92
mallard	*Anas platyrhynchos*	0	0	3	5	3	5
unidentified duck		2	11	0	0	2	11
unidentified merganser		1	1	0	0	1	1
wood duck	*Aix sponsa*	0	0	5	13	5	13
Shorebirds		**5**	**12**	**7**	**12**	**12**	**24**
killdeer	*Charadrius vociferus*	5	12	7	12	12	24
Gulls/Terns		**1**	**13**	**0**	**0**	**1**	**13**
unidentified gull		1	13	0	0	1	13
Rails/Coots		**1**	**1**	**0**	**0**	**1**	**1**
American coot	*Fulica americana*	1	1	0	0	1	1
Diurnal Raptors		**17**	**18**	**11**	**11**	**28**	**29**
American kestrel	*Falco sparverius*	3	3	1	1	4	4
Cooper's hawk	*Accipiter cooperii*	0	0	3	3	3	3
northern harrier	*Circus cyaneus*	1	1	1	1	2	2
red-tailed hawk	*Buteo jamaicensis*	11	12	6	6	17	18
sharp-shinned hawk	*Accipiter striatus*	1	1	0	0	1	1
unidentified hawk		1	1	0	0	1	1
Vultures		**14**	**18**	**16**	**31**	**30**	**49**
turkey vulture	*Cathartes aura*	14	18	16	31	30	49
Upland Game Birds		**2**	**2**	**1**	**1**	**3**	**3**
ring-necked pheasant	*Phasianus colchicus*	1	1	0	0	1	1
wild turkey	*Meleagris gallopavo*	1	1	1	1	2	2
Doves/Pigeons		**49**	**117**	**19**	**22**	**68**	**139**
mourning dove	*Zenaida macroura*	40	76	19	22	59	98
rock pigeon	*Columba livia*	8	37	0	0	8	37
unidentified dove		1	4	0	0	1	4

Appendix A. Summary of individuals (obs) and groups observations (grps) by bird type and species for passerine migration surveys at the Emerson Creek Wind Resource Area from September 1, 2010, to August 30, 2011.

Bird Type / Species	Scientific Name	Fall # of Grps.	Fall # of Obs.	Spring # of Grps.	Spring # of Obs.	Overall # of Grps.	Overall # of Obs.
Passerines		**1,095**	**3,529**	**1,053**	**1,543**	**2,148**	**5,072**
Corvids		*143*	*272*	*95*	*140*	*238*	*412*
American crow	*Corvus brachyrhynchos*	33	59	36	51	69	110
blue jay	*Cyanocitta cristata*	110	213	59	89	169	302
Passerines		*7*	*9*	*12*	*14*	*19*	*23*
unidentified passerine		7	9	12	14	19	23
Blackbirds/Orioles		*82*	*1,339*	*232*	*513*	*314*	*1,852*
Baltimore oriole	*Icterus galbula*	9	10	21	26	30	36
brown-headed cowbird	*Molothrus ater*	0	0	38	76	38	76
common grackle	*Quiscalus quiscula*	11	250	35	95	46	345
eastern meadowlark	*Sturnella magna*	0	0	4	4	4	4
European starling	*Sturnus vulgaris*	33	386	31	79	64	465
orchard oriole	*Icterus spurius*	0	0	3	4	3	4
red-winged blackbird	*Agelaius phoeniceus*	10	43	98	176	108	219
unidentified blackbird		19	650	2	53	21	703
Creepers/Nuthatches		*85*	*110*	*21*	*26*	*106*	*136*
brown creeper	*Certhia americana*	6	7	1	2	7	9
red-breasted nuthatch	*Sitta canadensis*	1	1	0	0	1	1
white-breasted nuthatch	*Sitta carolinensis*	78	102	20	24	98	126
Finches/Crossbills		*88*	*221*	*44*	*77*	*132*	*298*
American goldfinch	*Carduelis tristis*	85	214	41	74	126	288
house finch	*Carpodacus mexicanus*	3	7	3	3	6	10
Flycatchers		*63*	*67*	*42*	*50*	*105*	*117*
eastern kingbird	*Tyrannus tyrannus*	2	2	1	1	3	3
eastern phoebe	*Sayornis phoebe*	14	14	23	31	37	45
eastern wood-pewee	*Contopus virens*	44	48	17	17	61	65
great crested flycatcher	*Myiarchus crinitus*	1	1	1	1	2	2
least flycatcher	*Empidonax minimus*	1	1	0	0	1	1
willow flycatcher	*Empidonax traillii*	1	1	0	0	1	1
Gnatcatchers/Kinglet		*16*	*46*	*14*	*23*	*30*	*69*
blue-gray gnatcatcher	*Polioptila caerulea*	0	0	5	6	5	6
golden-crowned kinglet	*Regulus satrapa*	15	45	4	9	19	54
ruby-crowned kinglet	*Regulus calendula*	1	1	5	8	6	9
Grassland/Sparrows		*118*	*308*	*157*	*171*	*275*	*479*
American tree sparrow	*Spizella arborea*	6	18	1	1	7	19

Appendix A. Summary of individuals (obs) and groups observations (grps) by bird type and species for passerine migration surveys at the Emerson Creek Wind Resource Area from September 1, 2010, to August 30, 2011.

		Fall		Spring		Overall	
Bird Type / Species	**Scientific Name**	**# of Grps.**	**# of Obs.**	**# of Grps.**	**# of Obs.**	**# of Grps.**	**# of Obs.**
Cassin's sparrow	*Aimophila cassinii*	0	0	1	3	1	3
chipping sparrow	*Spizella passerina*	3	4	31	34	34	38
dark-eyed junco	*Junco hyemalis*	11	69	5	9	16	78
eastern towhee	*Pipilo erythrophthalmus*	0	0	6	6	6	6
field sparrow	*Spizella pusilla*	21	33	30	30	51	63
fox sparrow	*Passerella iliaca*	1	5	2	2	3	7
horned lark	*Eremophila alpestris*	11	47	3	4	14	51
house sparrow	*Passer domesticus*	5	15	0	0	5	15
Lincoln's sparrow	*Melospiza lincolnii*	3	5	0	0	3	5
savannah sparrow	*Passerculus sandwichensis*	3	3	3	3	6	6
song sparrow	*Melospiza melodia*	31	41	56	59	87	100
unidentified sparrow		10	29	4	5	14	34
vesper sparrow	*Pooecetes gramineus*	2	5	3	3	5	8
white-crowned sparrow	*Zonotrichia leucophrys*	2	18	11	11	13	29
white-throated sparrow	*Zonotrichia albicollis*	9	16	1	1	10	17
Mimids		*48*	*56*	*49*	*55*	*97*	*111*
brown thrasher	*Toxostoma rufum*	0	0	7	7	7	7
gray catbird	*Dumetella carolinensis*	48	56	41	47	89	103
northern mockingbird	*Mimus polyglottos*	0	0	1	1	1	1
Swallows		*37*	*75*	*22*	*35*	*59*	*110*
barn swallow	*Hirundo rustica*	15	29	6	9	21	38
northern rough-winged swallow	*Stelgidopteryx serripennis*	1	1	2	3	3	4
purple martin	*Progne subis*	2	2	2	2	4	4
tree swallow	*Tachycineta bicolor*	19	43	12	21	31	64
Tanagers/Grosbeaks/Cardinals		*85*	*114*	*82*	*96*	*167*	*210*
indigo bunting	*Passerina cyanea*	24	33	16	19	40	52
northern cardinal	*Cardinalis cardinalis*	51	69	56	65	107	134
rose-breasted grosbeak	*Pheucticus ludovicianus*	7	8	7	9	14	17
scarlet tanager	*Piranga olivacea*	3	4	2	2	5	6
summer tanager	*Piranga rubra*	0	0	1	1	1	1
Thrushes		*150*	*533*	*160*	*200*	*310*	*733*
American robin	*Turdus migratorius*	134	504	130	170	264	674
eastern bluebird	*Sialia sialis*	10	16	5	5	15	21
hermit thrush	*Catharus guttatus*	2	6	2	2	4	8
Swainson's thrush	*Catharus ustulatus*	2	5	1	1	3	6

Appendix A. Summary of individuals (obs) and groups observations (grps) by bird type and species for passerine migration surveys at the Emerson Creek Wind Resource Area from September 1, 2010, to August 30, 2011.

		Fall		Spring		Overall	
Bird Type / Species	**Scientific Name**	**# of Grps.**	**# of Obs.**	**# of Grps.**	**# of Obs.**	**# of Grps.**	**# of Obs.**
unidentified thrush		2	2	0	0	2	2
wood thrush	*Hylocichla mustelina*	0	0	22	22	22	22
Titmice/Chickadees		*60*	*123*	*31*	*42*	*91*	*165*
black-capped chickadee	*Poecile atricapilla*	29	58	11	14	40	72
Carolina chickadee	*Poecile carolinensis*	4	10	0	0	4	10
tufted titmouse	*Baeolophus bicolor*	27	55	20	28	47	83
Vireos		*17*	*20*	*9*	*9*	*26*	*29*
blue-headed vireo	*Vireo solitarius*	1	1	2	2	3	3
Philadelphia vireo	*Vireo philadelphicus*	1	1	0	0	1	1
red-eyed vireo	*Vireo olivaceus*	9	12	1	1	10	13
warbling vireo	*Vireo gilvus*	6	6	3	3	9	9
white-eyed vireo	*Vireo griseus*	0	0	1	1	1	1
yellow-throated vireo	*Vireo flavifrons*	0	0	2	2	2	2
Warblers		*77*	*186*	*44*	*52*	*121*	*238*
American redstart	*Setophaga ruticilla*	8	11	7	8	15	19
black-and-white warbler	*Mniotilta varia*	1	2	3	5	4	7
black-throated blue warbler	*Dendroica caerulescens*	1	1	0	0	1	1
black-throated green warbler	*Dendroica virens*	5	6	1	2	6	8
blackpoll warbler	*Dendroica striata*	1	1	1	1	2	2
blue-winged warbler	*Vermivora pinus*	0	0	1	1	1	1
Canada warbler	*Wilsonia canadensis*	2	2	0	0	2	2
cape may warbler	*Dendroica tigrina*	1	1	0	0	1	1
chestnut-sided warbler	*Dendroica pensylvanica*	3	3	0	0	3	3
common yellowthroat	*Geothlypis trichas*	3	3	6	9	9	12
Kentucky warbler	*Oporornis formosus*	0	0	1	1	1	1
magnolia warbler	*Dendroica magnolia*	6	9	2	2	8	11
Nashville warbler	*Vermivora ruficapilla*	6	8	1	1	7	9
palm warbler	*Dendroica palmarum*	0	0	1	1	1	1
pine warbler	*Dendroica pinus*	6	9	4	4	10	13
prairie warbler	*Dendroica discolor*	0	0	2	2	2	2
Tennessee warbler	*Vermivora peregrina*	1	1	1	1	2	2
unidentified warbler		5	11	0	0	5	11
Wilson's warbler	*Wilsonia pusilla*	2	3	0	0	2	3
yellow-rumped warbler	*Dendroica coronata*	24	113	7	7	31	120
yellow warbler	*Dendroica petechia*	2	2	6	7	8	9

Appendix A. Summary of individuals (obs) and groups observations (grps) by bird type and species for passerine migration surveys at the Emerson Creek Wind Resource Area from September 1, 2010, to August 30, 2011.

		Fall		Spring		Overall	
Bird Type / Species	**Scientific Name**	**# of Grps.**	**# of Obs.**	**# of Grps.**	**# of Obs.**	**# of Grps.**	**# of Obs.**
Waxwings		*8*	*39*	*0*	*0*	*8*	*39*
cedar waxwing	*Bombycilla cedrorum*	8	39	0	0	8	39
Wrens		*11*	*11*	*39*	*40*	*50*	*51*
Carolina wren	*Thryothorus ludovicianus*	1	1	4	5	5	6
house wren	*Troglodytes aedon*	10	10	35	35	45	45
Swifts/Hummingbirds		**9**	**10**	**0**	**0**	**9**	**10**
chimney swift	*Chaetura pelagica*	8	9	0	0	8	9
ruby-throated hummingbird	*Archilochus colubris*	1	1	0	0	1	1
Woodpeckers		**155**	**252**	**77**	**88**	**232**	**340**
downy woodpecker	*Picoides pubescens*	34	41	14	17	48	58
hairy woodpecker	*Picoides villosus*	35	38	11	14	46	52
northern flicker	*Colaptes auratus*	32	37	25	27	57	64
pileated woodpecker	*Dryocopus pileatus*	1	1	0	0	1	1
red-bellied woodpecker	*Melanerpes carolinus*	36	44	15	17	51	61
red-headed woodpecker	*Melanerpes erythrocephalus*	7	12	1	1	8	13
unidentified woodpecker		9	78	8	9	17	87
yellow-bellied sapsucker	*Sphyrapicus varius*	1	1	3	3	4	4
Kingfishers		**3**	**3**	**3**	**5**	**6**	**8**
belted kingfisher	*Ceryle alcyon*	3	3	3	5	6	8
Overall		**1,365**	**4,142**	**1,205**	**1,743**	**2,570**	**5,885**

Appendix B: All bird types and species observed at the Emerson Creek Wind Resource Area during raptor migration surveys from September 1, 2010, to April 29, 2011.

Appendix B. Total number of groups (grps) and individuals (obs) for each bird type, raptor subtype, and species by season and overall during Fall 2010 and Spring 2011 raptor migration surveys at the Emerson Creek Wind Resource Area.

		Fall		Spring		Overall	
Bird Type / Species	**Scientific Name**	**# of Grps.**	**# of Obs.**	**# of Grps.**	**# of Obs.**	**# of Grps.**	**# of Obs.**
Waterbirds		**2**	**2**	**11**	**19**	**13**	**21**
great blue heron	*Ardea herodias*	2	2	9	14	11	16
great egret	*Ardea alba*	0	0	1	2	1	2
sandhill crane	*Grus canadensis*	0	0	1	3	1	3
Waterfowl		**11**	**54**	**34**	**5,364**	**45**	**5,418**
Canada goose	*Branta canadensis*	7	38	7	36	14	74
common merganser	*Mergus merganser*	0	0	1	1	1	1
mallard	*Anas platyrhynchos*	0	0	1	4	1	4
northern pintail	*Anas acuta*	0	0	1	1	1	1
tundra swan	*Cygnus columbianus*	0	0	1	125	1	125
unidentified duck		4	16	5	464	9	480
unidentified waterfowl		0	0	16	4,728	16	4,728
wood duck	*Aix sponsa*	0	0	2	5	2	5
Shorebirds		**43**	**94**	**28**	**101**	**71**	**195**
American golden-plover	*Pluvialis dominica*	1	7	0	0	1	7
greater yellowlegs	*Tringa melanoleuca*	0	0	1	2	1	2
killdeer	*Charadrius vociferus*	41	58	23	37	64	95
unidentified sandpiper		0	0	1	25	1	25
unidentified shorebird		1	29	2	36	3	65
Wilson's snipe	*Gallinago delicata*	0	0	1	1	1	1
Gulls/Terns		**1**	**1**	**4**	**59**	**5**	**60**
Bonaparte's gull	*Larus philadelphia*	0	0	2	56	2	56
herring gull	*Larus argentatus*	0	0	1	1	1	1
unidentified gull		1	1	1	2	2	3
Diurnal Raptors		**140**	**150**	**159**	**174**	**299**	**324**
Accipiters		*15*	*15*	*6*	*7*	*21*	*22*
Cooper's hawk	*Accipiter cooperii*	12	12	5	6	17	18
sharp-shinned hawk	*Accipiter striatus*	3	3	1	1	4	4
Buteos		*76*	*80*	*102*	*114*	*178*	*194*
broad-winged hawk	*Buteo platypterus*	0	0	2	2	2	2
red-shouldered hawk	*Buteo lineatus*	0	0	2	2	2	2
red-tailed hawk	*Buteo jamaicensis*	76	80	97	109	173	189
rough-legged hawk	*Buteo lagopus*	0	0	1	1	1	1
Northern Harrier		*19*	*19*	*13*	*13*	*32*	*32*
northern harrier	*Circus cyaneus*	19	19	13	13	32	32
Eagles		*12*	*13*	*25*	*25*	*37*	*38*
bald eagle	*Haliaeetus leucocephalus*	12	13	25	25	37	38
Falcons		*14*	*19*	*3*	*3*	*17*	*22*
American kestrel	*Falco sparverius*	9	14	3	3	12	17
peregrine falcon	*Falco peregrinus*	1	1	0	0	1	1
unidentified falcon		4	4	0	0	4	4
Osprey		*1*	*1*	*0*	*0*	*1*	*1*
osprey	*Pandion haliaetus*	1	1	0	0	1	1
Other Raptors		*3*	*3*	*10*	*12*	*13*	*15*
unidentified hawk		3	3	10	12	13	15
Vultures		**488**	**599**	**382**	**582**	**870**	**1,181**
turkey vulture	*Cathartes aura*	488	599	382	582	870	1,181
Upland Game Birds		**4**	**34**	**3**	**6**	**7**	**40**
wild turkey	*Meleagris gallopavo*	4	34	3	6	7	40

Appendix B. Total number of groups (grps) and individuals (obs) for each bird type, raptor subtype, and species by season and overall during Fall 2010 and Spring 2011 raptor migration surveys at the Emerson Creek Wind Resource Area.

		Fall		Spring		Overall	
Bird Type / Species	Scientific Name	# of Grps.	# of Obs.	# of Grps.	# of Obs.	# of Grps.	# of Obs.
Doves/Pigeons		**23**	**40**	**2**	**3**	**25**	**43**
mourning dove	*Zenaida macroura*	19	30	1	1	20	31
rock pigeon	*Columba livia*	4	10	1	2	5	12
Passerines		**354**	**2,186**	**170**	**1,790**	**524**	**3,976**
American crow	*Corvus brachyrhynchos*	9	22	12	23	21	45
American goldfinch	*Carduelis tristis*	53	92	2	24	55	116
American pipit	*Anthus rubescens*	4	13	1	5	5	18
American robin	*Turdus migratorius*	15	28	9	135	24	163
barn swallow	*Hirundo rustica*	22	63	7	26	29	89
blue jay	*Cyanocitta cristata*	7	14	2	8	9	22
brown-headed cowbird	*Molothrus ater*	0	0	2	23	2	23
cliff swallow	*Petrochelidon pyrrhonota*	1	1	0	0	1	1
common grackle	*Quiscalus quiscula*	4	27	12	218	16	245
eastern bluebird	*Sialia sialis*	0	0	3	5	3	5
eastern meadowlark	*Sturnella magna*	2	2	5	5	7	7
European starling	*Sturnus vulgaris*	20	210	15	649	35	859
horned lark	*Eremophila alpestris*	102	445	63	200	165	645
house finch	*Carpodacus mexicanus*	6	13	0	0	6	13
house sparrow	*Passer domesticus*	2	4	0	0	2	4
northern rough-winged swallow	*Stelgidopteryx serripennis*	4	5	0	0	4	5
palm warbler	*Dendroica palmarum*	2	2	1	1	3	3
red-winged blackbird	*Agelaius phoeniceus*	4	33	21	268	25	301
savannah sparrow	*Passerculus sandwichensis*	6	13	4	4	10	17
song sparrow	*Melospiza melodia*	1	1	1	1	2	2
tree swallow	*Tachycineta bicolor*	65	681	6	6	71	687
unidentified blackbird		12	485	2	123	14	608
unidentified sparrow		13	32	2	66	15	98
Swifts/Hummingbirds		**19**	**28**	**0**	**0**	**19**	**28**
chimney swift	*Chaetura pelagica*	15	24	0	0	15	24
ruby-throated hummingbird	*Archilochus colubris*	4	4	0	0	4	4
Woodpeckers		**2**	**3**	**4**	**4**	**6**	**7**
downy woodpecker	*Picoides pubescens*	0	0	1	1	1	1
northern flicker	*Colaptes auratus*	2	3	1	1	3	4
pileated woodpecker	*Dryocopus pileatus*	0	0	1	1	1	1
red-bellied woodpecker	*Melanerpes carolinus*	0	0	1	1	1	1
Overall		**1,087**	**3,191**	**797**	**8,102**	**1,884**	**11,293**

Appendix C: All bird types and species observed at the Emerson Creek Wind Resource Area during bald eagle surveys from September 9, 2010, to August 29, 2011.

Appendix C. Summary of individuals and group observations by species and bird group for bald eagle surveys at the Emerson Creek Wind Resource Area from September 9, 2010, to August 29, 2011.

Bird Type / Species	Scientific Name	Breeding Season # of Grps.	Breeding Season # of Obs.	Winter # of Grps.	Winter # of Obs.	Overall # of Grps.	Overall # of Obs.
Waterbirds		**16**	**16**	**2**	**30**	**18**	**46**
double-crested cormorant	*Phalacrocorax auritus*	0	0	1	29	1	29
great blue heron	*Ardea herodias*	10	10	1	1	11	11
great egret	*Ardea alba*	6	6	0	0	6	6
Waterfowl		**10**	**48**	**0**	**0**	**10**	**48**
Canada goose	*Branta canadensis*	8	43	0	0	8	43
unidentified duck		2	5	0	0	2	5
Shorebirds		**97**	**164**	**14**	**64**	**111**	**228**
American golden-plover	*Pluvialis dominica*	0	0	1	27	1	27
killdeer	*Charadrius vociferus*	95	121	13	37	108	158
unidentified shorebird		2	43	0	0	2	43
Gulls/Terns		**3**	**4**	**0**	**0**	**3**	**4**
unidentified gull		3	4	0	0	3	4
Diurnal Raptors		**138**	**156**	**64**	**68**	**202**	**224**
Accipiters		*6*	*6*	*2*	*2*	*8*	*8*
Cooper's hawk	*Accipiter cooperii*	4	4	2	2	6	6
sharp-shinned hawk	*Accipiter striatus*	2	2	0	0	2	2
Buteos		*86*	*100*	*31*	*34*	*117*	*134*
red-tailed hawk	*Buteo jamaicensis*	85	99	31	34	116	133
unidentified buteo		1	1	0	0	1	1
Northern Harrier		*7*	*7*	*11*	*11*	*18*	*18*
northern harrier	*Circus cyaneus*	7	7	11	11	18	18
Eagles		*17*	*17*	*5*	*5*	*22*	*22*
bald eagle	*Haliaeetus leucocephalus*	17	17	5	5	22	22
Falcons		*17*	*21*	*9*	*10*	*26*	*31*
American kestrel	*Falco sparverius*	17	21	9	10	26	31
Osprey		*0*	*0*	*2*	*2*	*2*	*2*
osprey	*Pandion haliaetus*	0	0	2	2	2	2
Other Raptors		*5*	*5*	*4*	*4*	*9*	*9*
unidentified hawk		5	5	4	4	9	9
Vultures		**369**	**737**	**132**	**151**	**501**	**888**
turkey vulture	*Cathartes aura*	369	737	132	151	501	888
Upland Game Birds		**1**	**9**	**2**	**51**	**3**	**60**
wild turkey	*Meleagris gallopavo*	1	9	2	51	3	60
Doves/Pigeons		**105**	**224**	**11**	**39**	**116**	**263**
mourning dove	*Zenaida macroura*	91	159	7	12	98	171
rock pigeon	*Columba livia*	14	65	4	27	18	92
Large Corvids		**87**	**131**	**8**	**15**	**95**	**146**
American crow	*Corvus brachyrhynchos*	87	131	8	15	95	146
Passerines		**1,306**	**3,256**	**134**	**1,264**	**1,440**	**4,520**
American goldfinch	*Carduelis tristis*	103	162	15	31	118	193
American pipit	*Anthus rubescens*	0	0	1	15	1	15
American redstart	*Setophaga ruticilla*	1	1	0	0	1	1
American robin	*Turdus migratorius*	75	107	2	9	77	116
Baltimore oriole	*Icterus galbula*	8	8	0	0	8	8
barn swallow	*Hirundo rustica*	133	299	6	9	139	308
black-capped chickadee	*Poecile atricapilla*	1	1	1	1	2	2
blue-gray gnatcatcher	*Polioptila caerulea*	2	3	0	0	2	3
blue jay	*Cyanocitta cristata*	34	40	6	10	40	50

Appendix C. Summary of individuals and group observations by species and bird group for bald eagle surveys at the Emerson Creek Wind Resource Area from September 9, 2010, to August 29, 2011.

Bird Type / Species	Scientific Name	Breeding Season # of Grps.	Breeding Season # of Obs.	Winter # of Grps.	Winter # of Obs.	Overall # of Grps.	Overall # of Obs.
bobolink	*Dolichonyx oryzivorus*	10	10	0	0	10	10
brown-headed cowbird	*Molothrus ater*	7	16	0	0	7	16
brown thrasher	*Toxostoma rufum*	5	6	0	0	5	6
cedar waxwing	*Bombycilla cedrorum*	1	1	1	1	2	2
chipping sparrow	*Spizella passerina*	7	8	0	0	7	8
cliff swallow	*Petrochelidon pyrrhonota*	0	0	2	7	2	7
common grackle	*Quiscalus quiscula*	85	161	1	120	86	281
common yellowthroat	*Geothlypis trichas*	16	16	0	0	16	16
dark-eyed junco	*Junco hyemalis*	0	0	2	8	2	8
eastern bluebird	*Sialia sialis*	11	14	3	5	14	19
eastern kingbird	*Tyrannus tyrannus*	13	14	0	0	13	14
eastern meadowlark	*Sturnella magna*	16	21	0	0	16	21
eastern phoebe	*Sayornis phoebe*	7	8	0	0	7	8
eastern wood-pewee	*Contopus virens*	8	8	0	0	8	8
European starling	*Sturnus vulgaris*	93	584	8	212	101	796
field sparrow	*Spizella pusilla*	39	39	0	0	39	39
gray catbird	*Dumetella carolinensis*	16	17	0	0	16	17
great crested flycatcher	*Myiarchus crinitus*	1	1	0	0	1	1
Henslow's sparrow	*Ammodramus henslowii*	1	5	0	0	1	5
horned lark	*Eremophila alpestris*	111	234	45	190	156	424
house finch	*Carpodacus mexicanus*	2	2	0	0	2	2
house sparrow	*Passer domesticus*	40	74	1	22	41	96
house wren	*Troglodytes aedon*	7	7	0	0	7	7
indigo bunting	*Passerina cyanea*	21	22	0	0	21	22
Lapland longspur	*Calcarius lapponicus*	3	111	0	0	3	111
lark sparrow	*Chondestes grammacus*	2	3	0	0	2	3
northern cardinal	*Cardinalis cardinalis*	23	23	1	1	24	24
northern mockingbird	*Mimus polyglottos*	1	1	0	0	1	1
palm warbler	*Dendroica palmarum*	0	0	2	2	2	2
purple martin	*Progne subis*	8	12	0	0	8	12
red-winged blackbird	*Agelaius phoeniceus*	192	405	0	0	192	405
rose-breasted grosbeak	*Pheucticus ludovicianus*	1	1	0	0	1	1
savannah sparrow	*Passerculus sandwichensis*	70	77	0	0	70	77
song sparrow	*Melospiza melodia*	45	49	0	0	45	49
tree swallow	*Tachycineta bicolor*	47	141	30	512	77	653
tufted titmouse	*Baeolophus bicolor*	2	3	0	0	2	3
unidentified blackbird		1	500	6	107	7	607
unidentified passerine		2	3	0	0	2	3
unidentified sparrow		2	3	1	2	3	5
vesper sparrow	*Pooecetes gramineus*	18	19	0	0	18	19
white-breasted nuthatch	*Sitta carolinensis*	4	4	0	0	4	4
white-crowned sparrow	*Zonotrichia leucophrys*	1	2	0	0	1	2
willow flycatcher	*Empidonax traillii*	1	1	0	0	1	1
wood thrush	*Hylocichla mustelina*	6	6	0	0	6	6
yellow warbler	*Dendroica petechia*	3	3	0	0	3	3

Appendix C. Summary of individuals and group observations by species and bird group for bald eagle surveys at the Emerson Creek Wind Resource Area from September 9, 2010, to August 29, 2011.

Bird Type / Species	Scientific Name	Breeding Season # of Grps.	Breeding Season # of Obs.	Winter # of Grps.	Winter # of Obs.	Overall # of Grps.	Overall # of Obs.
Swifts/Hummingbirds		**3**	**8**	**0**	**0**	**3**	**8**
chimney swift	*Chaetura pelagica*	1	6	0	0	1	6
ruby-throated hummingbird	*Archilochus colubris*	2	2	0	0	2	2
Woodpeckers		**13**	**14**	**8**	**14**	**21**	**28**
downy woodpecker	*Picoides pubescens*	1	2	3	3	4	5
hairy woodpecker	*Picoides villosus*	1	1	2	2	3	3
northern flicker	*Colaptes auratus*	5	5	1	1	6	6
red-bellied woodpecker	*Melanerpes carolinus*	1	1	2	8	3	9
red-headed woodpecker	*Melanerpes erythrocephalus*	3	3	0	0	3	3
unidentified woodpecker		2	2	0	0	2	2
Kingfishers		**1**	**1**	**0**	**0**	**1**	**1**
belted kingfisher	*Ceryle alcyon*	1	1	0	0	1	1
Overall		**2,149**	**4,768**	**375**	**1,696**	**2,524**	**6,464**

[a] Regardless of distance from observer.

Appendix D: Mean use, percent of use, and frequency of occurrence for large birds and small birds observed during bald eagle surveys at the Emerson Creek Wind Resource Area from September 9, 2010, to August 29, 2011.

Appendix D1. Mean bird use (number of birds/800-meter plot/20-minute survey), percent of use (%), and frequency of occurrence (%) for each large bird type and species by season during the bald eagle surveys at the Emerson Creek Wind Resource Area from September 9, 2010, to August 29, 2011.

	Mean Use		% of Use		% Frequency	
Bird Type / Species	**Breeding Season**	**Winter**	**Breeding Season**	**Winter**	**Breeding Season**	**Winter**
Waterbirds	**0.06**	**0.21**	**1.1**	**7.1**	**5.8**	**1.4**
double-crested cormorant	0	0.21	0	6.9	0	0.7
great blue heron	0.03	<0.01	0.6	0.2	3.3	0.7
great egret	0.02	0	0.5	0	2.5	0
Waterfowl	**0.21**	**0**	**3.9**	**0**	**4.6**	**0**
Canada goose	0.20	0	3.7	0	4.2	0
unidentified duck	0.01	0	0.2	0	0.4	0
Shorebirds	**0.70**	**0.47**	**13.0**	**15.5**	**36.7**	**10.2**
American golden-plover	0	0.19	0	6.4	0	0.7
killdeer	0.52	0.27	9.7	9.1	35.8	9.4
unidentified shorebird	0.18	0	3.3	0	0.8	0
Gulls/Terns	**0.03**	**0**	**0.5**	**0**	**2.1**	**0**
unidentified gull	0.03	0	0.5	0	2.1	0
Diurnal Raptors	**0.59**	**0.48**	**10.9**	**16.0**	**37.9**	**34.4**
Accipiters	*0.02*	*0.01*	*0.4*	*0.5*	*1.7*	*1.4*
Cooper's hawk	0.01	0.01	0.2	0.5	1.2	1.4
sharp-shinned hawk	<0.01	0	0.2	0	0.4	0
Buteos	*0.36*	*0.24*	*6.6*	*7.9*	*27.5*	*18.7*
red-tailed hawk	0.35	0.24	6.6	7.9	27.1	18.7
unidentified buteo	<0.01	0	<0.1	0	0.4	0
Northern Harrier	*0.03*	*0.08*	*0.5*	*2.6*	*2.9*	*7.1*
northern harrier	0.03	0.08	0.5	2.6	2.9	7.1
Eagles	*0.07*	*0.04*	*1.2*	*1.2*	*2.9*	*3.6*
bald eagle	0.07	0.04	1.2	1.2	2.9	3.6
Falcons	*0.09*	*0.07*	*1.6*	*2.4*	*7.1*	*5.7*
American kestrel	0.09	0.07	1.6	2.4	7.1	5.7
Osprey	*0*	*0.01*	*0*	*0.5*	*0*	*1.4*
osprey	0	0.01	0	0.5	0	1.4
Other Raptors	*0.03*	*0.03*	*0.5*	*1*	*2.9*	*2.9*
unidentified hawk	0.03	0.03	0.5	1	2.9	2.9
Vultures	**2.33**	**1.09**	**43.2**	**36.2**	**66.2**	**40.3**
turkey vulture	2.33	1.09	43.2	36.2	66.2	40.3
Upland Game Birds	**0.04**	**0.37**	**0.7**	**12.2**	**0.4**	**1.5**
wild turkey	0.04	0.37	0.7	12.2	0.4	1.5
Doves/Pigeons	**0.94**	**0.28**	**17.3**	**9.3**	**33.3**	**6.4**
mourning dove	0.67	0.09	12.3	2.9	30.4	3.6
rock pigeon	0.27	0.19	5.0	6.4	5.8	2.9
Large Corvids	**0.50**	**0.11**	**9.3**	**3.6**	**29.2**	**5.8**
American crow	0.50	0.11	9.3	3.6	29.2	5.8
Overall	**5.40**	**3.00**	**100**	**100**		

Appendix D2. Mean bird use (number of birds/100-meter plot/20-minute survey), percent of use (%), and frequency of occurrence (%) for each small bird type and species by season during the bald eagle surveys at the Emerson Creek Wind Resource Area from September 9, 2010, to August 29, 2011.

	Mean Use		% of Use		% Frequency	
Bird Type / Species	**Breeding Season**	**Winter**	**Breeding Season**	**Winter**	**Breeding Season**	**Winter**
Passerines	**11.57**	**9.08**	**99.4**	**98.9**	**80.0**	**59.9**
American goldfinch	0.68	0.22	5.8	2.4	36.7	10.0
American pipit	0	0.11	0	1.2	0	0.7
American redstart	<0.01	0	<0.1	0	0.4	0
American robin	0.48	0.07	4.1	0.7	25.0	1.5
Baltimore oriole	0.03	0	0.3	0	3.3	0
barn swallow	1.24	0.06	10.7	0.7	37.9	4.3
black-capped chickadee	0	<0.01	0	<0.1	0	0.7
blue-gray gnatcatcher	0.01	0	0.1	0	0.8	0
blue jay	0.06	0.07	0.5	0.8	5.4	4.3
bobolink	0.03	0	0.3	0	2.1	0
brown-headed cowbird	0.08	0	0.7	0	3.3	0
brown thrasher	0.02	0	0.2	0	2.1	0
cedar waxwing	<0.01	<0.01	<0.1	<0.1	0.4	0.7
chipping sparrow	0.03	0	0.3	0	2.9	0
cliff swallow	0	0.05	0	0.5	0	1.4
common grackle	0.61	0.86	5.2	9.3	23.8	0.7
common yellowthroat	0.05	0	0.5	0	5.4	0
dark-eyed junco	0	0.06	0	0.6	0	1.4
eastern bluebird	0.06	0.04	0.5	0.4	5.0	2.1
eastern kingbird	0.05	0	0.4	0	4.6	0
eastern meadowlark	0.08	0	0.7	0	5.8	0
eastern phoebe	0.02	0	0.2	0	1.7	0
eastern wood-pewee	0.03	0	0.3	0	2.9	0
European starling	2.47	1.54	21.2	16.8	27.1	5.9
field sparrow	0.06	0	0.5	0	5.4	0
gray catbird	0.06	0	0.5	0	5.4	0
great crested flycatcher	<0.01	0	<0.1	0	0.4	0
Henslow's sparrow	0.02	0	0.2	0	0.4	0
horned lark	1.23	1.37	10.6	14.9	31.7	28.9
house finch	<0.01	0	<0.1	0	0.8	0
house sparrow	0.31	0.16	2.6	1.7	14.6	0.7
house wren	0.03	0	0.3	0	2.9	0
indigo bunting	0.07	0	0.6	0	6.2	0
Lapland longspur	0.46	0	4.0	0	0.8	0
lark sparrow	0.01	0	0.1	0	0.8	0
northern cardinal	0.03	<0.01	0.3	<0.1	2.9	0.7
palm warbler	0	0.01	0	0.2	0	1.4
purple martin	0.04	0	0.3	0	2.5	0
red-winged blackbird	1.92	0	16.5	0	38.3	0
rose-breasted grosbeak	<0.01	0	<0.1	0	0.4	0
savannah sparrow	0.32	0	2.7	0	24.2	0
song sparrow	0.20	0	1.7	0	16.2	0
tree swallow	0.59	3.66	5.0	39.9	12.9	19.5
tufted titmouse	0.01	0	0.1	0	0.8	0
unidentified blackbird	0	0.77	0	8.4	0	4.4
unidentified passerine	0.01	0	0.1	0	0.8	0
unidentified sparrow	0.01	0.01	0.1	0.2	0.8	0.7
vesper sparrow	0.08	0	0.6	0	7.1	0

Appendix D2. Mean bird use (number of birds/100-meter plot/20-minute survey), percent of use (%), and frequency of occurrence (%) for each small bird type and species by season during the bald eagle surveys at the Emerson Creek Wind Resource Area from September 9, 2010, to August 29, 2011.

	Mean Use		% of Use		% Frequency	
Bird Type / Species	**Breeding Season**	**Winter**	**Breeding Season**	**Winter**	**Breeding Season**	**Winter**
white-breasted nuthatch	0.01	0	0.1	0	1.2	0
white-crowned sparrow	<0.01	0	<0.1	0	0.4	0
willow flycatcher	<0.01	0	<0.1	0	0.4	0
wood thrush	0.01	0	0.1	0	0.8	0
yellow warbler	0.01	0	0.1	0	1.2	0
Swifts/Hummingbirds	**0.03**	**0**	**0.3**	**0**	**1.2**	**0**
chimney swift	0.02	0	0.2	0	0.4	0
ruby-throated hummingbird	<0.01	0	<0.1	0	0.8	0
Woodpeckers	**0.04**	**0.10**	**0.3**	**1.1**	**2.9**	**4.3**
downy woodpecker	<0.01	0.02	<0.1	0.2	0.4	2.1
hairy woodpecker	<0.01	0.01	<0.1	0.2	0.4	1.4
northern flicker	0.01	<0.01	0.1	<0.1	1.2	0.7
red-bellied woodpecker	<0.01	0.06	<0.1	0.6	0.4	1.4
red-headed woodpecker	<0.01	0	<0.1	0	0.8	0
Kingfishers	**<0.01**	**0**	**<0.1**	**0**	**0.4**	**0**
belted kingfisher	<0.01	0	<0.1	0	0.4	0
Overall	**11.65**	**9.18**	**100**	**100**		

Appendix E: North American Fatality Summary Tables

Appendix E1. Comparison of raptor use estimates and raptor mortality at wind-energy facilities in North America and the Emerson Creek Wind Resource Area.

Wind Energy Facility	Raptor Mortality[b]	No. of Turbines	Total MW
Emerson Creek, OH	0.07		
California			
Diablo, CA	0.87	31	20.46
SMUD Solano, CA	0.53	22	15
Shiloh I, CA	0.44	100	150
Pine Tree, CA	0.133	90	135
Alite, CA	0.12	8	24
Dillon, CA	0	45	45
Midwest			
Buffalo Ridge, MN (Phase I; 1996)	0.47	73	25
Moraine II, MN	0.37	33	49.5
Winnebago, IA	0.27	10	20
Buffalo Ridge I, SD (2010)	0.2	24	50.4
NPPD Ainsworth, NE	0.06	36	20.5
Prairie Winds (Minot), ND	0.05	80	115.5
Kewaunee County, WI	0	31	20.46
Grand Ridge, IL	0	66	99
Elm Creek, MN	0	67	100
Blue Sky Green Field, WI	0	88	145
Northeastern			
Noble Ellenburg, NY (2009)	0.49	54	80
Noble Ellenburg, NY (2008)	0.32	54	80
Noble Clinton, NY (2008)	0.29	67	100
Maple Ridge, NY (2007)	0.25	195	321.75
Noble Clinton, NY (2009)	0.24	67	100
Noble Bliss, NY (2008)	0.19	67	100
Noble Bliss, NY (2009)	0.18	67	100
Maple Ridge, NY (2008)	0.03	195	321.75
Lempster, NH (2009)	0	12	24
Lempster, NH (2010)	0	12	24
Pacific Northwest			
Tuolumne (Windy Point I), WA	0.29	62	136.6
Leaning Juniper, OR	0.21	67	100.5
Biglow Canyon, OR (Phase II; 2009/2010)	0.2	65	150
Goodnoe, WA	0.17	47	94
Big Horn, WA	0.15	133	199.5
Klondike III, OR	0.15	122	375
Hopkins Ridge, WA (2006)	0.14	83	150
Klondike II, OR	0.11	50	75
Wild Horse, WA	0.09	127	229
Stateline, OR/WA 2002	0.09	454	263
Stateline, OR/WA 2003	0.09	454	263
Hopkins Ridge, WA (2008)	0.07	87	156.6
Elkhorn, OR (2008)	0.06	61	101
Klondike IIIa, OR	0.06	125	375
Nine Canyon, WA	0.05	37	48.1
Marengo II, WA (2009)	0.05	39	70.2
Pebble Springs, OR	0.04	47	98.7
Biglow Canyon, OR (Phase I; 2009)	0.04	76	125.4
Biglow Canyon, OR (Phase I; 2008)	0.03	76	125.4
Klondike, OR	0	16	24

Appendix E1. Comparison of raptor use estimates and raptor mortality at wind-energy facilities in North America and the Emerson Creek Wind Resource Area.

Wind Energy Facility	Raptor Mortality[b]	No. of Turbines	Total MW
Vansycle, OR	0	38	24.9
Combine Hills, OR	0	41	41
Marengo I, WA (2009)	0	39	70.2
Hay Canyon, OR	0	48	100.8
Rocky Mountains			
Summerview, Alb (2006)	0.11	39	70.2
Foote Creek Rim, WY (Phase I; 1999)	0.08	69	41.4
Foote Creek Rim, WY (Phase I; 2000)	0.05	69	41.4
Foote Creek Rim, WY (Phase I; 2001-2002)	0	69	41.4
Southeastern			
Buffalo Mountain, TN (2000-2003)	0	3	1.98
Buffalo Mountain, TN (2005)	0	18	28.98
Southern Plains			
Barton Chapel, TX	0.5	60	120
Southwestern			
Dry Lake, AZ	0	30	63

[a] number of fatalities/MW/year

Data from the following sources:

Facility	Reference	Facility	Reference
Diablo, CA	WEST 2006, WEST 2008	Goodnoe, WA	URS 2010a
SMUD Solano, CA	URS,Erickson et al. 2005	Big Horn, WA	Kronner et al. 2008
Shiloh I, CA	Kerlinger et al. 2010	Klondike III, OR	Gritski et al. 2009
Pine Tree, CA	BioResource Consultants 2010	Hopkins Ridge, WA (2006)	Young et al. 2007
Alite, CA	Chatfield et al. 2010	Klondike II, OR	NWC and WEST 2007
Dillon, CA	Chatfield et al. 2009	Wild Horse, WA	Erickson et al. 2008
Buffalo Ridge, MN (Phase I; 1996)	Johnson et al. 2000	Stateline, OR/WA 2002	Erickson et al. 2004
Moraine II, MN	Derby et al 2010	Stateline, OR/WA 2003	Erickson et al. 2004
Winnebago, IA	Derby et al 2010	Hopkins Ridge, WA (2008)	Young et al. 2009
Buffalo Ridge I, SD (2010)	Derby et al 2010	Elkhorn, OR (2008)	Jeffery et al. 2009
NPPD Ainsworth, NE	Derby et al. 2007	Klondike IIIa, OR	Gritski et al. 2009
Prairie Winds (Minot), ND	Derby et al. 2011	Nine Canyon, WA	Erickson et al. 2003b
Kewaunee County, WI	Howe et al. 2002	Marengo II, WA (2009)	URS 2010c
Grand Ridge, IL	Derby et al 2010	Pebble Springs, OR	Gritski and Kronner 2010b
Elm Creek, MN	Derby et al 2010	Biglow Canyon, OR (Phase I; 2009)	Enk et al. 2010
Blue Sky Green Field, WI	Gruver et al. 2009	Biglow Canyon, OR (Phase I; 2008)	Jeffrey et al. 2009
Noble Ellenburg, NY (2009)	Jain et al. 2008	Klondike, OR	Johnson et al. 2003b
Noble Ellenburg, NY (2008)	Jain et al. 2009	Vansycle, OR	Erickson et al. 2000
Noble Clinton, NY (2008)	Jain et al. 2009	Combine Hills, OR	Young et al. 2006
Maple Ridge, NY (2007)	Jain et al. 2008	Marengo I, WA (2009)	URS 2010b
Noble Clinton, NY (2009)	Jain et al. 2008	Hay Canyon, OR	Gritski and Kronner 2010a
Noble Bliss, NY (2008)	Jain et al. 2009	Summerview, Alb (2006)	Brown and Hamilton 2006
Noble Bliss, NY (2009)	Jain et al. 2008	Foote Creek Rim, WY (Phase I; 1999)	Young et al. 2003b
Maple Ridge, NY (2008)	Jain et. al 2009d	Foote Creek Rim, WY (Phase I; 2000)	Young et al. 2003b
Lempster, NH (2009)	Tidhar et al. 2010	Foote Creek Rim, WY (Phase I; 2001-2002)	Young et al. 2003b
Lempster, NH (2010)	Tidhar et al. 2011	Buffalo Mountain, TN (2000-2003)	Nicholson et al. 2005
Tuolumne (Windy Point I), WA	Enz and Bay 2010	Buffalo Mountain, TN (2005)	Fiedler et al. 2007
Leaning Juniper, OR	Kronner et al. 2007	Barton Chapel, TX	WEST 2011
Biglow Canyon, OR (Phase II; 2009/2010)	Enk et al. 2011	Dry Lake, AZ	Thompson et al. 2011

Appendix E2. Wind-energy facilities in North America with fatality data for all bird species, grouped by geographic region.

Wind Energy Facility	Fatality Estimate[a]	No. of Turbines	Total MW
Califonia			
Pine Tree, CA	8.3	90	135
Shiloh I, CA	6.96	100	150
Dillon, CA	4.71	45	45
Diablo, CA	4.29	31	20.46
High Winds, CA (2004)	1.62	90	162
High Winds, CA (2005)	1.1	90	162
SMUD Solano, CA	0.99	22	15
Alite, CA	0.55	8	24
Midwest			
Wessington Springs, SD	8.25	34	51
Blue Sky Green Field, WI	7.17	88	145
Cedar Ridge, WI (2009)	6.55	41	67.6
Buffalo Ridge, MN (Phase III; 1999)	5.93	138	103.5
Moraine II, MN	5.59	33	49.5
Buffalo Ridge I, SD (2010)	5.06	24	50.4
Buffalo Ridge, MN (Phase I; 1996)	4.14	73	25
Winnebago, IA	3.88	10	20
Cedar Ridge, WI (2010)	3.72	41	68
Buffalo Ridge, MN (Phase II; 1999)	3.57	143	107.25
Buffalo Ridge, MN (Phase I; 1998)	3.14	73	25
Ripley, Ont (2008)	3.09	38	76
Buffalo Ridge, MN (Phase I; 1997)	2.51	73	25
Buffalo Ridge, MN (Phase II; 1998)	2.47	143	107.25
Kewaunee County, WI	1.95	31	20.46
NPPD Ainsworth, NE	1.63	36	20.5
Elm Creek, MN	1.55	67	100
Prairie Winds (Minot), ND	1.48	80	115.5
Buffalo Ridge, MN (Phase I; 1999)	1.43	73	25
Top of Iowa, IA (2004)	0.81	89	80
Grand Ridge, IL	0.48	66	99
Top of Iowa, IA (2003)	0.42	89	80
Northeastern			
Mount Storm, WV (2009)	5.73	132	264
Noble Ellenburg, NY (2009)	3.79	54	80
Maple Ridge, NY (2007)	3.44	195	321.75
Lempster, NH (2009)	3.38	12	24
Casselman, PA (Spring & Fall 2008)	3.13	23	34.5
Mountaineer, WV	3	44	68
Noble Bliss, NY (2008)	2.86	67	100
Noble Bliss, NY (2009)	2.81	67	100
Stetson Mountain, ME (2009)	2.68	38	57
Lempster, NH (2010)	2.64	12	24
Noble Clinton, NY (2008)	2.17	67	100
Maple Ridge, NY (2008)	2.07	195	321.75
Cohocton/Dutch Hill, NY (2009)	1.88	50	125
Mars Hill, ME (2008)	1.76	28	42
Mars Hill, ME (2007)	1.67	28	42
Munnsville, NY (2008)	1.48	23	34.5
Noble Ellenburg, NY (2008)	1.4	54	80
Noble Clinton, NY (2009)	1.17	67	100

Appendix E2. Wind-energy facilities in North America with fatality data for all bird species, grouped by geographic region.

Wind Energy Facility	Fatality Estimate[a]	No. of Turbines	Total MW
Pacific Northwest			
Biglow Canyon, OR (Phase II; 2009/2010)	7.72	65	150
Leaning Juniper, OR	6.66	67	100.5
Tuolumne (Windy Point I), WA	3.2	62	136.6
Stateline, OR/WA 2002	3.17	454	263
Klondike II, OR	3.1	50	75
Klondike III, OR	3.02	122	375
Hopkins Ridge, WA (2008)	2.99	87	156.6
Klondike IIIa, OR	2.8	125	375
Nine Canyon, WA	2.76	37	48.1
Stateline, OR/WA 2003	2.68	454	263
Combine Hills, OR	2.56	41	41
Big Horn, WA	2.54	133	199.5
Biglow Canyon, OR (Phase I; 2009)	2.47	76	125.4
Hay Canyon, OR	2.21	48	100.8
Pebble Springs, OR	1.93	47	98.7
Biglow Canyon, OR (Phase I; 2008)	1.76	76	125.4
Wild Horse, WA	1.55	127	229
Goodnoe, WA	1.4	47	94
Hopkins Ridge, WA (2006)	1.23	83	150
Klondike, OR	0.95	16	24
Vansycle, OR	0.95	38	24.9
Elkhorn, OR (2008)	0.64	61	101
Marengo I, WA (2009)	0.27	39	70.2
Marengo II, WA (2009)	0.16	39	70.2
Rocky Mountains			
Foote Creek Rim, WY (Phase I; 1999)	3.4	69	41.4
Foote Creek Rim, WY (Phase I; 2000)	2.42	69	41.4
Foote Creek Rim, WY (Phase I; 2001-2002)	1.93	69	41.4
Summerview, Alb (2006)	1.06	39	70.2
Southeastern			
Buffalo Mountain, TN (2000-2003)	13.93	3	1.98
Buffalo Mountain, TN (2005)	1.1	18	28.98
Southern Plains			
Barton Chapel, TX	1.15	60	120
Southwestern			
Dry Lake, AZ	2.22	30	63

[a] number of fatalities/MW/year

Data from the following sources:

Facility	Reference	Facility	Reference
Pine Tree, CA	BioResource Consultants 2010	Noble Clinton, NY (2008)	Jain et al. 2009
Shiloh I, CA	Kerlinger et al. 2010	Maple Ridge, NY (2008)	Jain et. al 2009d
Dillon, CA	Chatfield et al. 2009	Cohocton/Dutch Hill, NY (2009)	Stantec 2010
Diablo, CA	WEST 2006, WEST 2008	Mars Hill, ME (2008)	Stantec 2009
High Winds, CA (2004)	Kerlinger 2006	Mars Hill, ME (2007)	Stantec 2008b
High Winds, CA (2005)	Kerlinger 2006	Munnsville, NY (2008)	Stantec 2009
SMUD Solano, CA	URS,Erickson et al. 2005	Noble Ellenburg, NY (2008)	Jain et al. 2009
Alite, CA	Chatfield et al. 2010	Noble Clinton, NY (2009)	Jain et al. 2008
Wessington Springs, SD	Derby et al 2010	Biglow Canyon, OR (Phase II; 2009/2010)	Enk et al. 2011
Blue Sky Green Field, WI	Gruver et al. 2009	Leaning Juniper, OR	Kronner et al. 2007
Cedar Ridge, WI (2009)	BHE Environmental 2010	Tuolumne (Windy Point I), WA	Enz and Bay 2010
Buffalo Ridge, MN (Phase III; 1999)	Johnson et al. 2000	Stateline, OR/WA 2002	Erickson et al. 2004
Moraine II, MN	Derby et al 2010	Klondike II, OR	NWC and WEST 2007
Buffalo Ridge I, SD (2010)	Derby et al 2010	Klondike III, OR	Gritski et al. 2009
Buffalo Ridge, MN (Phase I; 1996)	Johnson et al. 2000	Hopkins Ridge, WA (2008)	Young et al. 2009
Winnebago, IA	Derby et al 2010	Klondike IIIa, OR	Gritski et al. 2009

Appendix E2. Wind-energy facilities in North America with fatality data for all bird species, grouped by geographic region.

Wind Energy Facility		Fatality Estimate[a]	No. of Turbines	Total MW
Cedar Ridge, WI (2010)	BHE 2011	Nine Canyon, WA	Erickson et al. 2003b	
Buffalo Ridge, MN (Phase II; 1999)	Johnson et al. 2000	Stateline, OR/WA 2003	Erickson et al. 2004	
Buffalo Ridge, MN (Phase I; 1998)	Johnson et al. 2000	Combine Hills, OR	Young et al. 2006	
Ripley, Ont (2008)	Stantec 2009	Big Horn, WA	Kronner et al. 2008	
Buffalo Ridge, MN (Phase I; 1997)	Johnson et al. 2000	Biglow Canyon, OR (Phase I; 2009)	Enk et al. 2010	
Buffalo Ridge, MN (Phase II; 1998)	Johnson et al. 2000	Hay Canyon, OR	Gritski and Kronner 2010a	
Kewaunee County, WI	Howe et al. 2002	Pebble Springs, OR	Gritski and Kronner 2010b	
NPPD Ainsworth, NE	Derby et al. 2007	Biglow Canyon, OR (Phase I; 2008)	Jeffrey et al. 2009	
Elm Creek, MN	Derby et al 2010	Wild Horse, WA	Erickson et al. 2008	
Prairie Winds (Minot), ND	Derby et al. 2011	Goodnoe, WA	URS 2010a	
Buffalo Ridge, MN (Phase I; 1999)	Johnson et al. 2000	Hopkins Ridge, WA (2006)	Young et al. 2007	
Top of Iowa, IA (2004)	Jain 2005	Klondike, OR	Johnson et al. 2003b	
Grand Ridge, IL	Derby et al 2010	Vansycle, OR	Erickson et al. 2000	
Top of Iowa, IA (2003)	Jain 2005	Elkhorn, OR (2008)	Jeffery et al. 2009	
Mount Storm, WV (2009)	Young et. al 2010	Marengo I, WA (2009)	URS 2010b	
Noble Ellenburg, NY (2009)	Jain et al. 2008	Marengo II, WA (2009)	URS 2010c	
Maple Ridge, NY (2007)	Jain et al. 2008	Foote Creek Rim, WY (Phase I; 1999)	Young et al. 2003b	
Lempster, NH (2009)	Tidhar et al. 2010	Foote Creek Rim, WY (Phase I; 2000)	Young et al. 2003b	
Casselman, PA (Spring & Fall 2008)	Arnett et al. 2009	Foote Creek Rim, WY (Phase I; 2001-2002)	Young et al. 2003b	
Mountaineer, WV	Kerns and Kerlinger 2004	Summerview, Alb (2006)	Brown and Hamilton 2006	
Noble Bliss, NY (2008)	Jain et al. 2009	Buffalo Mountain, TN (2000-2003)	Nicholson et al. 2005	
Noble Bliss, NY (2009)	Jain et al. 2008	Buffalo Mountain, TN (2005)	Fiedler et al. 2007	
Stetson Mountain, ME (2009)	Stantec 2009	Barton Chapel, TX	WEST 2011	

Exhibit S
Raptor Migration/Use Surveys

4. Avian Survey Report dated July 20, 2012

Christine M.T. Pirik (0029759)
(Counsel of Record)
Terrence O'Donnell (0074213)
William V. Vorys (0093479)
Dickinson Wright PLLC
150 East Gay Street, Suite 2400
Columbus, Ohio 43215
Phone: (614) 591-5461
Email: cpirik@dickinsonwright.com
todonnell@dickinsonwright.com
wvorys@dickinsonwright.com

Attorneys for Firelands Wind, LLC

TETRA TECH

July 20, 2012

Ms. Jennifer Norris
Olentangy Wildlife Research Station
Ohio Department of Natural Resources-Division of Wildlife
8589 Horseshoe Road
Ashley, Ohio 43003

Re: Avian Survey Report
Proposed Firelands/Lyme Wind Project
Seneca, Huron and Erie Counties, Ohio
Tetra Tech Project Number: 103P178401

Dear Ms. Norris:

On behalf of our client, Firelands Wind Farm, LLC and Lyme Wind Farm LLC (Firelands/Lyme), Tetra Tech EM Inc. (Tetra Tech) is pleased to provide the enclosed Avian Survey Report for the proposed Firelands/Lyme Wind Energy Project located in Huron and Erie Counties, Ohio. The enclosed report provides a summary of avian survey activities conducted and results for the Firelands/Lyme project. All studies have been performed in accordance with the Firelands/Lyme Avian and Bat Plan submitted and approved by the United Fish and Wildlife Service (USFWS) and Ohio Department of Natural Resources (ODNR) in March 2011.

We appreciate your input and feedback and look forward to continuing our working relationship with the USFWS and ODNR on this important project. Should you have any questions or require additional information, please do not hesitate to contact me directly by phone at 513-333-3662 or via electronic mail at douglas.mcilvain@tetratech.com .

Sincerely,

Tetra Tech

Douglas J McIlvain

Douglas McIlvain
Senior Project Manager

Enclosures

Cc: Keith Lott, USFWS
Matthew Krivos, Firelands/Lyme Project Manager

AVIAN SURVEY REPORT

FIRELANDS/LYME WIND FARM

SENECA, HURON AND ERIE COUNTIES, OHIO

Prepared for:

Firelands Wind Farm, LLC and Lyme Wind Farm LLC
629 Euclid Avenue, Suite 635
Cleveland, Ohio 44114

Submitted by:

Tetra Tech EM Inc.
250 West Court Street, Suite 200W
Cincinnati, Ohio 45202

Tetra Tech Project #103P178401

July 2012

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1.0 INTRODUCTION

Firelands Wind Farm, LLC and Lyme Wind Farm LLC (Firelands/Lyme) are proposing to construct a wind energy facility in Erie, Huron and Seneca Counties, Ohio (see Figure 1 – Site Location Map). Firelands/Lyme contracted Tetra Tech EM, Inc. (Tetra Tech) to conduct various surveys and studies required for successful permitting and development of the proposed project. Tetra Tech prepared this report to document the multiple avian surveys conducted, and it provides background information, a description of the existing site conditions, survey methodologies, survey results, survey discussion, and conclusions.

1.1 Project Description & Background

Firelands/Lyme is proposing to construct a wind energy facility across approximately 43,000 acres (Project Area) of primarily agricultural lands in Erie, Huron and Seneca Counties, Ohio (see Figure 1). The proposed facility will include the construction of approximately 62 turbines, or approximately 99 megawatts (MW) of installed wind capacity. For the purposes of these avian biological surveys, the Firelands Project Area and the Lyme Project Area were evaluated together and hereafter are referred to as the "Project Area". The completed wind energy facility will also include development of infrastructure (transmission lines, substation facilities, access roads, etc.).

Firelands/Lyme is proposing to utilize turbines that are 100 meters (m) above the ground surface at the hub height with blades 50 m in length. Therefore, for the purposes of this report Tetra Tech utilized a rotor swept zone (RSZ) from 50 m to 150 m above the ground surface.

1.2 Purpose

The purpose of the avian survey effort was to gather site specific data to characterize the bird community within the Project Area. The data and conclusions of these surveys can be used to subsequently assess the potential risk to breeding and/or migrating birds from the proposed wind facility.

The scope of work was conducted in accordance with the *Avian and Bat Study Plan* dated March 23, 2011 (Study Plan), which was submitted to Ms. Melanie Cota of the United States Fish and Wildlife Service (USFWS) Columbus, Ohio Field Office and Ms. Jennifer Norris of the Ohio Department of Natural Resources, Division of Wildlife (ODNR). Approval of the *Avian and Bat Study Plan* was received from the USFWS in an electronic mail dated April 27, 2011 and ODNR on May 21, 2011 (Appendix A). Additionally, the avian survey followed the ODNR *On-shore Bird and Bat Pre- and Post-Construction Monitoring Protocol for Commercial Wind Energy Facilities in OH* (2009), the 2011 *USFWS Draft Land-Based Wind Energy Guidelines* (ODNR/USFWS wind guidelines), and the survey recommendations outlined in correspondence received by Tetra Tech on May 21, 2011 from ODNR Wind Energy Lead, Jennifer Norris (Appendix A).

Firelands/Lyme was classified by ODNR as a "moderate effort" site in a letter dated May 21, 2011 (Appendix A), and specific avian surveys required by ODNR under this classification included raptor nest identification and monitoring, diurnal raptor/bird migration surveys, breeding bird surveys, and site specific Bald Eagle nest monitoring and surveys.

In addition to ODNR/USFWS wind guidelines, the potential impacts to birds are regulated under several federal and state laws. Therefore the approved Study Plan was designed and conducted in accordance with the following state and federal laws including:

- The Endangered Species Act (ESA) of 1973 (7 U.S.C. § 136, 16 U.S.C. § 1531 et seq.)

- The Migratory Bird Treaty Act (MTBA) of 1918 (16 U.S.C. 703-712; Ch. 128; July 13, 1918; 40 Stat. 755)

- The National Environmental Policy Act (NEPA) of 1969 (42 USC 4321)

- The USFWS Draft Eagle Conservation Plan Guidance (Draft ECPG), January 2011

- The Bald and Golden Eagle Protection Act (BGEPA) of 1940 (16 U.S.C. 668-668d, 54 Stat. 250)

- Ohio Revised Code Title 15 Conservation of Natural Resources (Chapter 1531.01 - 1531.25)

Tetra Tech initiated field efforts and surveys on March 2, 2011.

2.0 EXISTING SITE CONDITIONS

Tetra Tech biologists evaluated the Project Area and surrounding region with a desktop review and site visits in accordance with the Study Plan. Tetra Tech determined that there was a general lack of relevant information or site specific data for either the habitat or avian communities in the Project Area. The following sections provide an overview of site conditions for the surrounding region and the specific Project Area.

2.1 Region

Erie, Huron, and Seneca Counties are located in northwestern Ohio (Figure 1) in the Maumee and Erie Lake Plain physiographic provinces, which are characterized by level to gently rolling terrain and clay and loamy clay lakebed soils. Prior to settlement, much of this region was covered by various mixed hardwood forest types. However, due to the fertile soil, the area is now predominantly agricultural (crop) land with only scattered forest remnants or woodlots located primarily along stream channels or in isolated stands. Two large waterways, the Sandusky and Huron Rivers are found within this region. These rivers flow from south to north from interior northwest Ohio to Lake Erie. A band of natural habitat, including upland and floodplain forests and wetlands occur along these river channels. In addition, Lake Erie and Sandusky Bay are located approximately 5 to 10 miles to the north of the Project Area (see Figure 2) and harbors shoreline and open water habitats. The Sandusky River corridor is located 12 to 16 miles west of the Project Area and within Sandusky, Seneca and Wyandot Counties. The Sandusky River corridor is designated by the Audubon Society as the Sandusky Important Bird Area (IBA), while a large portion of Lake Erie including Sandusky Bay is designated as the Lake Erie Western Basin IBA. The Sandusky IBA is known as a Bald Eagle (*Haliaeetus leucocephalus*) migration corridor and is important to a number of songbird species. The Lake Erie Western Basin IBA is known to be an important wintering and nesting area for Bald Eagles as well as numerous waterfowl and waterbird species.

A majority of the wetlands in the agricultural portion of this region have been greatly reduced in size and extent; however, small areas of emergent marsh/meadow, farm ponds, and floodplain/bottomland forest still occur in isolated patches or along riparian stream corridors.

2.2 Project Area

The vast majority (over 98%) of the Project Area has been converted to cropland or other high intensity development. Forest stands and other natural habitats consist of less than 900 of the 43,000 acres of the Project Area, and are scattered and highly fragmented (see Figure 3).

Despite the reduction of forest and wetland acreage the Project Area has the potential to provide habitat for a number of common avian species to be observed during the avian surveys. The existing open fields and disturbed croplands are areas typically associated with Killdeer (*Charadrius vociferus*), Brown-headed cowbird (*Molothrus ater*) and Horned Lark (*Eremophila alpestris*), as well as invasive European starlings (*Sturnus vulgaris*). The few remaining forest stands or woodlots within the Project Area could provide habitat for certain forest interior dwelling species (FIDS) and other passerine species during breeding and/or seasonal migration. However, the diversity of the passerine population would be mainly limited to common thrushes (*Turdidae*) and sparrows (*Passeridae*) typically associated with fragmented scrub/shrub habitat and widespread throughout North America.

A few small tributary streams, which comprise approximately 159 linear miles, traverse the Project Area, some of which flow through or are adjacent to scattered wooded areas or woodlots. Some of these drainages contain small forested wetlands or floodplain areas and may provide habitat for common wading birds and waterfowl species such as Great blue herons (*Ardea herodias*) and Mallards (*Anas platyrhynchos*). No larger rivers or water bodies occur within the Project Area. There is a quarry located along the north western boundary of the Project Area (see Figure 1) that contains ponded water and the artificial Bellevue Reservoir is located adjacent to southern boundary and outside of the Project Area (see Figure 1).

The proximity (<5 miles) of these water bodies to Lake Erie and other IBAs with documented Bald Eagle nesting provides potential habitat within the Project Area. Tetra Tech scientists noted that the Huron River likely provides greater foraging potential for Bald Eagles than much of the Project Area due to the significant extent of natural habitat and an open water body. The Huron River may also provide a migration corridor to and from Lake Erie. However, many of the stream channels have been modified through extensive agricultural practices, which may limit their potential as critical habitat for Bald Eagles.

3.0 SURVEY METHODOLOGY

The following sections describe the avian biological survey methods completed by Tetra Tech biologists beginning March 2, 2011 and completed on March 22, 2012. The avian surveys were conducted in accordance with the approved Study Plan, ODNR/USFWS wind guidelines, and the ODNR project specific survey recommendations (Appendix A).

3.1 Raptor Nest Searching & Monitoring

Tetra Tech biologists conducted raptor nest searching in March 2011 and again in March 2012. In accordance with the approved Study Plan, a random-systematic searching approach using vehicular reconnaissance was conducted to identify all raptor nests within the 2-mile ODNR wind guidelines buffer area and Bald Eagle nests within the Draft ECPG 10-mile buffer area. Each observed nest was identified to species by nest size, material and/or bird activity at the nest. Global Positioning Satellite (GPS) locations of each confirmed nest were recorded using a handheld Trimble GeoX (Figure 2).

Tetra Tech biologists also conducted Bald Eagle nest searches within the 10-mile Draft ECPG buffer of the Project Area (see Figure 2) in accordance with the Study Plan. For the purposes of this report, the results of the 2-mile ODNR wind guidelines buffer nest survey for all raptor species are reported in detail in Section 4.1.

The results of the 10-mile Draft ECPG buffer survey for Bald Eagles are summarized and reported in detail in the 2011-2012 site specific Bald Eagle surveys in the *Stage 2-Site Specific Bald Eagle Survey Preliminary Results (March-August 2011) and Risk Assessment Protocol Framework* dated February 10, 2012 and the pending *Stage 2 - Site Specific Bald Eagle Survey Report* that will be completed in July 2012.

3.2 Diurnal Raptor & Bird Migration Survey

Tetra Tech biologists initiated diurnal raptor and bird migration survey efforts, in accordance with the approved Study Plan, on March 16, 2011. A single diurnal raptor and bird migration survey (diurnal raptor/bird survey) sample point location (see Figure 4) with a 1.5-mile observation radius was centrally located in the Firelands portion of the Project Area and surveyed three times (3x) weekly from March 15 to April 28, 2011 and from September 1 to October 28, 2011 (see photographs included in Appendix B).

The sample point location was chosen to best represent the Project Area existing conditions and to determine the degree to which the Project Area serves as a potential migratory pathway, “fall out”, or concentration area of migratory species (Figure 4). Because over 98% of the Firelands/Lyme Project Area has been converted to cropland (see Figure 3) an appropriate sample point was determined to be situated in an agricultural field containing a woodlot and stream to act as a potential “fall out” area for migratory avian species. A second sample point location, with the similar habitat characteristics as the first, was centrally located within the Lyme portion of the Project Area, at the request of ODNR in their letter dated April 16, 2011 (Appendix A), during the fall surveys (September 1 to October 31, 2011).

During the diurnal raptor/bird surveys all birds observed were counted and identified to species when possible. Tetra Tech biologists identified individuals by ear or by sight with the aid of up to 48x60 magnification scope. Additional information recorded for individuals included the ODNR data collection categorical flight height (0-40 m, 41-180 m, and >180 m) above ground, flight heading and number of minutes within the RSZ. Additionally, Tetra Tech biologists recorded detailed flight paths of raptor species observations on site specific topographic maps and an hourly raptor summary on Hawk Migration Association of North America (HMANA) data sheets in accordance to the Tetra Tech Raptor Survey Standard Operating Procedures (SOP), 2010. Tetra Tech Hourly weather data including visibility, precipitation, cloud cover, temperature, humidity, wind speed and direction were recorded as well. Tetra Tech has compiled copies of field forms and data sheets from all avian survey efforts, which are included on the compact disk (CD) included as Appendix C.

3.2.1 Data Analysis

Diurnal raptor/bird survey data was compiled and analyzed using Excel spreadsheets. The analysis and results will characterize diurnal raptor/bird use and behavior in the Project Area as they relate to the potential issues associated with the construction and operation of a wind energy facility. This included analyzing and reporting the data to summarize the following:

1. What species were observed during the survey (species composition);

2. How many species were observed (species richness);

3. The total number of individuals observed (overall abundance);

4. What species, or species group were most abundant versus those species or species group were least abundant (relative proportion or abundance of each species or species group);

5. During what time of year were individuals most abundant versus what time of year birds were least abundant (overall temporal distribution);

6. During what time of year were each species or species group most abundant versus what time of year each species or species group were least abundant (individual species temporal distribution);

7. Flight height of all individuals observed, on average (overall average flight height); and

8. Flight height of each species or species group observed, on average (individual species average flight height).

An accurate account of the species that occur within the Project Area is important for determining whether any federal or state listed bird species use the Project Area and therefore could possibly be affected by Firelands/Lyme activities. The total number of birds and the species or species groups which are most abundant provides an indication of whether the bird community using the Project Area is comprised of a few common bird species or species groups, or consists of a diverse range of species. Determining what time of year birds are most abundant versus least abundant and how high individuals are flying is important for identifying the extent the avian community may be susceptible to collisions with wind turbines (towers, hubs, or spinning blades) and other structures. When evaluated together, this set of results yields a reasonable approximation of the level of impact the proposed wind energy facility may have on the avian community as a whole.

Note that raptor data were separated from other non-raptor diurnal bird data and analyzed independently. Results of the analysis of both raptor and non-raptor diurnal data are therefore reported separately in Section 4.0. In addition to the analysis methods described above, raptor data were further evaluated by comparing raptor results to other regional raptor survey data to evaluate migration activity in the study area from a regional perspective (Section 5.2.1).

Data for both raptors and non-raptors were analyzed for each two week period (referred as diurnal survey period) beginning March 15 to April 30, 2011 for the spring and September 15 to October 31, 2011 for the fall and, unless otherwise indicated, diurnal survey results are reported using the seven diurnal survey period ending dates (see Table 1).

The following describes the specific methods and/or computations that were used to derive each of the previously listed results.

3.2.2 Species Composition & Richness

Species composition is reported by a list of all individual bird species observed by Tetra Tech biologists, and their number or count. Species richness is the number of species groups observed by Tetra Tech biologists.

3.2.3 Overall Bird Abundance

The total number of individuals observed, or overall abundance was determined by both a count of all individuals observed and by determining the overall encounter rate. Encounter rate is the average number of individuals observed per hour of survey and is calculated by dividing the total number of individuals recorded by the total number of hours of survey or by the following formula:

$$\text{Encounter Rate} = \left(\frac{\substack{\text{Total Count of Individuals Recorded} \\ \text{within Diurnal Survey Period}}}{\text{Total Diurnal Survey Period Hours}} \right)$$

Encounter rate was also used to measure bird abundance, because it provides a measure of bird abundance regardless of the actual number of surveys conducted.

3.2.4 Relative Abundance

What species groups were most abundant or the relative proportion of the total number of individuals for each species group was determined by calculating the relative proportion (percentage) each species contributed to the total number of individuals and was calculated using the following formula:

$$\text{Relative Abundance} = \left(\frac{\text{Count of Individual Species A}}{\text{Total Count of Individuals}} \right) \text{X } 100$$

3.2.5 Overall Temporal Distribution

The time of year when birds were least/most abundant, or the overall temporal distribution of birds observed was determined by calculating the encounter rate for all individuals recorded during each two week period over the course of the survey. The encounter rate for all individuals recorded for each diurnal survey period was calculated using the following formula:

$$\text{Overall Temporal Distribution} = \left(\frac{\begin{array}{c}\text{Total Individuals within each}\\ \text{Diurnal Survey Period}\end{array}}{\text{Total Diurnal Survey Period Hours}} \right)$$

3.2.6 Individual Species Temporal Distribution

The time of year when each individual species or species group was most abundant versus when they were least abundant, or the temporal distribution of each species or species group was determined by calculating the encounter rate for each raptor and non-raptor species or species group during each two week diurnal survey period. The encounter rate for each individual species or species group during each two week diurnal survey period was calculated using the following formula:

$$\text{Individual Species Temporal Distribution} = \left(\frac{\begin{array}{c}\text{Total Count of Individuals Recorded}\\ \text{within each Species within Diurnal Survey Period}\end{array}}{\text{Total Diurnal Survey Period Hours}} \right)$$

3.2.7 Overall Average Flight Height

To determine how high birds were flying on average, or the overall average flight height, individual observations were first placed into the following ODNR data collection flight height categories as described under the field investigation methods:

- Category 1 (0 – 40 m)
- Category 1 & 2 (0 – 180 m)
- Category 2 (41 – 180 m)
- Category 2 & 3 (41 - >180 m)
- Category 3 (>180 m)

Next, the average, or mean for each flight height category was calculated to be the following:

- Category 1 (0 – 40 m) = mean of 20 m
- Category 1 & 2 (0 – 180 m) = mean of 90 m
- Category 2 (41 – 180 m) = mean of 110 m
- Category 2 & 3 (41 - >180 m) = mean of 180 m
- Category 3 (>180 m) = mean of 200 m

Then, the number of individuals observed in each flight height category was multiplied by the mean value for that category. These products were then added together to yield an overall sum that was then divided by the total number of individual observations. This provided an average flight height for all individuals recorded that was "weighted" by the number of individuals observed in each of the flight height categories.

The formula for this computation is as follows:

$$\text{Weighted Average Flight Height} = \sum\left(\frac{\begin{matrix}\text{Total Count of All Individuals}\\ \text{in Flight Height Category A}\end{matrix}}{\text{Total Count of All Individual Observations}}\right)$$

3.2.8 Individual Species or Species Group Average Flight Height

To determine how high individual species or species groups were flying on average, or the species or species group average flight height data were analyzed using the same process as described above for the overall average flight height but used the following specific formula:

$$\begin{matrix}\text{Individual Species}\\ \text{Weighted Average Flight Height}\end{matrix} = \left(\frac{\left[\Sigma\left\{\begin{matrix}\text{Count of Individual Species B}\\ \text{in Flight Height Catagory A} \times \text{Average Value of Category A}\end{matrix}\right\}\right]}{\text{Total Diurnal Survey Period Hours}}\right)$$

Tetra Tech assumes that the selected turbine will have a hub height of 100 m above the ground surface and blades of 50 m in length. Therefore the RSZ and all calculations in reference to the RSZ assume that it is 50 m to 150 m above the ground surface height.

3.3 Breeding Bird Survey

In order to determine the status of the Project Area's breeding bird population, Tetra Tech followed the breeding bird survey (BBS) protocol in the approved Study Plan. Tetra Tech biologists utilized the Bald Eagle fixed radius point count locations (see section 3.5 below and Figure 5) to conduct early morning breeding bird surveys in May and June 2011. Copies of completed field forms are included in Appendix C.

In accordance with the Study Plan, three avian point counts were conducted, lasting ten minutes each, at 35 BBS point count locations (Figure 5). Tetra Tech biologists initiated each BBS no earlier than 30 minutes before dawn and did not extend past 10:00 A.M. eastern standard time (EST). Each BBS required two days to complete due to the number of point counts and time restrictions (May 19 – 20, June 1 - 2, and June 16 – 17, 2011). All birds detected (by sight or ear) during surveys were identified to species and their behavior recorded using appropriate reference codes (refer to breeding bird atlas codes), estimated distance, and direction (bearing) were also recorded. Birds flying overhead that did not land or originate within 200 m of the center of the point were recorded as "fly over." Due to reduced detectability, surveys were not conducted on mornings with heavy wind (>5 meters/second), prolonged periods of rain (>20 minutes), or fog.

3.3.1 Data Analysis

BBS data analysis methods included determining species composition, species richness, and overall/relative abundance as described previously for the diurnal raptor/bird analysis. Species composition included recording a list of all species observed, while species richness was determined by a count of the number of species recorded. Overall abundance was determined by the total count of all birds observed. Relative abundance was determined by first combining individual species into species groups and then calculating the relative proportion (percentage) that each species group contributed to the total number of individuals recorded using the formula:

$$\text{Relative Abundance} = \left(\frac{\text{Count of Speices Group A}}{\text{Total Count of Individuals Recorded}}\right) \times 100$$

Temporal distribution was not calculated for the BBS data because the breeding bird survey is considered to be a discrete survey conducted over the course of less than a month.

3.4 Site Specific Bald Eagle Surveys

As part of the Study Plan for Firelands/Lyme Project Area Tetra Tech biologists completed one full year of site specific Bald Eagle surveys (March 2, 2011 to March 22, 2012). Tetra Tech followed the guidelines in the Study Plan and completed the ODNR and USFWS approved methodology identified in the letter dated April 16, 2011 (Appendix A). Preliminary Bald Eagle survey results were provided in the *Stage 2-Site Specific Bald Eagle Survey Preliminary Results (March-August 2011) and Risk Assessment Protocol Framework* dated February 10, 2012 and will be finalized in the pending *Firelands/Lyme Site Specific Bald Eagle Survey Report* that will be completed in July 2012.

3.5 Greater Sandhill Crane Migration Survey

Tetra Tech biologists incidentally observed the listed State of Ohio endangered bird species the Greater sandhill Crane (*Grus canadensis tabida*) on two separate occasions, April 26, 2011 and June 29, 2011 during the site specific Bald Eagle point count surveys (see Greater Sandhill Crane Point Count Locations 28 and 22, Figure 6). Following these incidental occurrences Tetra Tech and Firelands/Lyme coordinated with ODNR regarding additional survey efforts during the fall 2011 migration season as described in an October 17, 2011 letter. Tetra Tech and ODNR agreed (via electronic mail) on the additional species specific Greater sandhill crane survey efforts on October 24, 2011 (Appendix A).

As approved by ODNR, Tetra Tech conducted two additional surveys for the Greater sandhill crane from November 1, 2011 through December 15, 2011. Tetra Tech biologists incorporated an additional level of effort for Greater sandhill cranes during the Bald Eagle point count survey periods. Tetra Tech biologists monitored 40 fixed radius point count locations for 30 minutes each between 9:00 A.M. and 4:00 P.M. EST, twice a month for Greater sandhill cranes (see Figure 6). In addition, Tetra tech conducted diurnal Greater sandhill crane migration surveys at two diurnal/raptor and bird migration survey locations (Figure 4), three times weekly from 9:00 A.M. to 4:00 P.M. EST, during those weeks when no Greater sandhill crane point counts were being conducted. Tetra Tech incorporated species specific (i.e. sandhill cranes) data collection field forms with survey methodology and protocols during the Greater sandhill crane point counts (Appendix C).

4.0 SURVEY RESULTS

The following section provides a summary of the results of the avian surveys completed within the approximately 43,000 acre Firelands/Lyme Project Area and 10-mile Draft ECPG buffer between March 2, 2011 and March 22, 2012 (Figure 2). Tetra Tech biologists completed a desktop review for the Project Area for site specific information, which did not result in any habitat or bird community data. Prior to the initiation of survey efforts Tetra tech biologists located survey sites in accordance to the Study Plan. The diurnal raptor/bird survey sampling sites are depicted in Figure 4. Breeding bird and Greater sandhill crane survey points were located within the 10-mile Draft ECPG buffer of the Project Area (Figures 5 and 6). The results of the raptor nest searching within the 2-mile ODNR wind guidelines buffer, diurnal raptor/bird survey, breeding bird survey, and Greater sandhill crane survey are provided in the following sections.

4.1 Raptor Nest Searching & Monitoring

Tetra Tech biologists completed a detailed raptor nest reconnaissance survey of the Project Area, the 2-mile ODNR wind guidelines buffer, and the Draft ECPG 10-mile buffer. The surveys were conducted from March 2, 2011 to March 23, 2011 and from March 6, 2012 to March 16, 2012. Red-tailed hawk nests were identified to be approximately 3-feet wide and one to six foot tall pile of dry sticks, while Bald Eagle nests were over 5-feet wide and at least three foot tall piles of dry tree limbs and by observed raptor activity at the nest. Tetra Tech biologists confirmed individual raptor species activity at the nest by observing either a Red-tailed hawk or Bald Eagle approaching the nest, performing breeding activity at the nest (nest building, incubation, etc.), perched on, and/or within 800 m of the nest. A total of seven Red-tailed hawk and eight Bald Eagle nests were identified by Tetra Tech biologists in 2011 (Figure 2). Since Red-tailed hawks are not a State of Ohio or Federal listed species no additional nest monitoring was conducted of identified Red-tailed hawk nests per ODNR wind guidelines.

In 2011, seven nests (#1, #3, #4, #5, #6, #7, and #8) were found to be occupied by Bald Eagles. Nest #2 was observed to be occupied by a Red-tailed hawk. Tetra Tech biologists did not observe Bald Eagle fledglings for nests #5 and #6, therefore they were unproductive. Tetra Tech determined that the two nests (#1 and #2) in the Project Area were from the same pair of Bald Eagles that abandoned one nest (#2) and constructed another (#1).

During the 2012 vehicular reconnaissance Tetra tech biologists observed 11 Bald Eagle nest locations, which included three new nests, identified as #7_2012, #8_2012, and #9 on Figure 2. Nest #2 was observed to be unoccupied by any birds. Tetra Tech biologists determined that the two nests (#7 and #8) observed in 2011 had been destroyed and were no longer present. Tetra Tech biologists determined that due to the proximity to the old nest locations (see Figure 2) that the new nests (#7_2012 and #8_2012) were most likely re-nests by breeding pairs from the previous year nests #7 and #8. Thus, a total of nine nest locations were monitored in 2012, eight were occupied by Bald Eagles, and four of the occupied nests were determined to be productive. It should also be noted that Tetra Tech biologists periodically observed the locations of the original Bald Eagle nests at locations #7 and #8 through the end of productivity monitoring in 2012 to ensure no replacement nests were constructed.

4.2 Diurnal Raptor & Bird Migration Survey

A total of 48 day-long diurnal raptor/bird surveys were conducted at the two sample locations in the Project Area over the spring and fall migration periods (Figure 4). The sample point located in the Firelands portion of the Project Area was surveyed during the spring, and both the sample points (Firelands and Lyme were sampled during the fall of 2011. Sampling in the fall was rotated between the two sampling locations. During the spring survey (March 15, 2011 through May 1, 2011) 21 day-long diurnal raptor/bird surveys were completed while 27 day-long diurnal raptor/bird surveys were conducted during the fall survey period (September 1, 2011 through October 31, 2011).

Each full day diurnal raptor/bird survey was conducted for seven hours between 8:30 A.M. and 4:00 P.M. EST, resulting in 147 hours of total observation time in the spring and 189 hours of total observation time during the fall survey period.

A total of 15,668 bird observations representing 83 species were recorded during the diurnal bird/raptor migration survey. Of the 83 species observed nine were raptors. The remaining 74 non-raptors included 55 passerines (*Passeriformes*), nine waterfowl (*Aneriformes*), five shorebirds (*Charadriiformes*), three gulls (*Laridae*), and two wading bird species.

4.2.1 Raptor Species Composition & Richness

The nine raptor species observed (Table 1) during the spring and fall diurnal raptor/bird survey included American kestrel (*Falco sparverius*), Bald Eagle, Broad-winged hawk (*Buteo platypterus*), Cooper's hawk (*Accipiter cooperii*), Northern harrier (*Circus cyaneus*), Osprey (*Pandion haliaetus*), Red-tailed hawk, Sharp-shinned hawk (*Accipiter striatus*), and Turkey vulture (*Cathartes aura*). Of these only the Bald Eagle and Northern harrier are listed by the State of Ohio and none of the raptors observed were Federally listed species.

4.2.2 Overall Raptor Species Abundance

A total of 823 raptor observations were made over the spring and fall diurnal raptor/bird migration periods (Table 1). Of the 823 raptors observed, 80.1% (*n* = 659) were Turkey vulture. Red-tailed hawk 8.9% (*n* = 73) accounted the second largest species group observed, while Northern harrier 3.3% (*n* = 27), Cooper's hawk 2.8% (*n* = 23), Bald Eagle (*n* = 14), American kestrel (*n* = 11), and Sharp-shinned hawk (*n* = 8) each accounted for between 1% and 4% of raptors detected. The remaining species including Broad-winged hawk (*n* = 7) and Osprey (*n* = 1) were less than 1% of all raptors recorded (Table 1).

4.2.3 Raptor Species Temporal Distribution

As depicted in Table 1, a greater number of raptors were observed during the spring than in fall, with 432 raptors recorded in spring and 391 during the fall. Raptor observations were relatively consistent in early spring (March) and peaked in early to mid-April when nearly 200 (~25%) of the total 823 raptors were observed. The raptor observations then declined to 85 individuals at the end of April. The fall raptor observations were relatively consistent over most of the diurnal raptor/bird survey period between early September and mid-October but steeply declined to the lowest number of 38 raptor observations of all the 2011 diurnal survey periods at the end of October.

Turkey vulture, the species with the greatest percentage (~80%) of raptor observations overall the diurnal raptor/bird surveys, was observed in relatively consistent numbers throughout both the spring and fall periods. One Osprey was observed in the spring, and the other six raptor species were also observed in consistent numbers throughout both diurnal raptor/bird survey periods, with Broad-winged and Sharp-shinned hawks as the only two species with relatively lower numbers in the spring than fall (Table 1).

4.2.4 Raptor Species Encounter Rates

In addition to total counts of raptors observed, the encounter rate of individual species observed was calculated. Encounter rate was based on the number of individuals observed per hour and gives a measure of bird abundance regardless of the actual number of survey hours during each period. The encounter rate for all raptors over the entire spring and fall diurnal survey efforts was 2.45 individuals per hour. The encounter rate for all raptors observed during the spring diurnals was 2.94 individuals per hour, while the encounter rate for the fall diurnals was 2.07 individuals per hour. Figure 7 depicts the encounter rate of all raptor species per diurnal survey period during both the spring and fall.

Figure 7 depicts that encounter rates for all raptors observed were consistent during March and peaked in early to mid-April, but then decreased at the end of April. For the fall survey period, the encounter rate for all raptor species was greatest early in September, and then leveled off during most of September and early/mid-October, and finally decreased at the end of the October.

Figure 8 displays the temporal distribution for Turkey vultures observed over the course of the survey effort, and Figure 9 displays the temporal distribution of the other raptor species observed over the course of the survey effort. As can be seen, the most abundant raptor species during the peak encounter rates in the first half of April included Turkey vulture (3.74) and Red-tailed hawk (0.38), as well as Northern harrier (0.19), American kestrel (0.10), and Cooper's hawk (0.10). This same pattern was generally observed throughout the spring and fall survey period including the period with the lowest overall raptor encounter rate, the last half of October.

As can be noted in Figure 9 and Table 2 most raptors had relatively consistent encounter rates over the entire survey with the exception of Broad-winged and Sharp-shinned hawk, which were primarily observed in the fall. Broad-winged hawk was primarily observed in September with a peak encounter rate of 0.08 individuals / hour in early September. Sharp-shinned hawk was observed both in September and October with a peak encounter rate of 0.08 individuals / hour during the first half of October.

Turkey vulture, the most abundant species overall, had an encounter rate averaging around 2 individuals / hour over all the spring diurnals with a peak of over 3.5 individuals / hour in the first half of April (Table 2). This encounter rate is nearly 10X higher than the Red-tailed hawk encounter rate, the next most abundant species, during the same survey period. Turkey vulture had similar encounter rates in the fall; however, the encounter rate for this species declined to less than 1 individuals / hour during the last half of October. The Turkey vulture was also one of only two raptor species observed (Red tailed hawk was the other) during every diurnal survey period (see Table 1).

Red-tailed hawk followed a similar temporal pattern as the Turkey vulture with encounter rates averaging around 0.25 individuals / hour over most of the spring survey period and a peak of 0.38 individuals / hour in the first half of April.

4.2.5 Raptor Species Spatial Distribution

Individual directions of flight were recorded to evaluate the primary direction of raptor migration across the Project Area during the spring and fall periods. The percentage of raptors observed flying in each direction (NW, N, NE, W, E, SW, S, SE) during the spring and fall period are listed in Table 3.

There were no clear trends with regard to the direction of flight during either the spring or fall periods (Table 3). During the spring diurnal raptor/bird surveys, raptor direction of flight was somewhat evenly distributed among all observations with the largest percentage of raptors (~21%) with a direction of flight south and the lowest percentage (~4.5%) southwest. The remaining direction of flights (NW, N, NE, W, E and SE) ranged from about 8% to 12% of all raptor observations. During the fall diurnal raptor/bird surveys, raptor direction of flight was evenly distributed across all flight directions with the largest percentage of raptor observations (~17.5%) direction of flight south and the lowest percentage (~4.5%) having a direction of flight northwest. The remaining directions of flight (N, NE, W, E, SW, and SE) ranged from about 8% to 10% of all raptor observations.

4.2.6 Raptor Species Flight Height

The weighted average flight height calculation, as detailed in Section 3.2.7, determines the average measured height of flight for the number of individuals within a specific species or group observed at each categorical height within a diurnal survey period(s). The weighted average flight height calculated for all raptors observed during all the spring and fall diurnal survey periods was approximately 86 m. As depicted in Figure 10, this average flight height falls within the proposed turbine RSZ for Firelands/Lyme, which is 50 m to 150 m.

A majority of raptors (~66%) were observed flying in the RSZ during the spring and fall diurnal raptor/bird surveys. Approximately 30% of all raptors observed during the spring and fall diurnal raptor/bird surveys were recorded below the RSZ and only around 4% were recorded above the RSZ. The average flight height of all raptors species during the diurnal survey periods also fell within the RSZ except during the last fall diurnal survey period (Figure 11).

Osprey had the highest overall average flight height at around 180 m; however, only one Osprey was observed. The next highest average flight height was for Bald Eagle with an average flight height of over 100 m. The most abundant species, Turkey vulture and Red-tailed Hawk, had an average flight height of around 92 m and 72 m respectively. While some of the lesser abundant species such as the Northern harrier, Sharp-shinned hawk, Cooper’s hawk, and American kestrel had lower average flight heights ranging between 20 m and 40 m (Figure 10).

4.2.7 Non-Raptor Species & Groups Overall Abundance

A total of 94% (*n* = 15,668) of the diurnal raptor/bird survey individuals were non-raptors. The largest percentage (86.99%) of the 14,841 non-raptor species observed were passerines and other landbirds (Table 4). Waterfowl and Gulls made up 4.67% (*n* = 693) and 4.93% (*n* = 731) of the total number of individuals observed. Shorebirds and wading birds were far less numerous and made up 3.23% and 0.19% of all non-raptor individuals observed.

The most abundant passerine/landbird species observed during the diurnal raptor/bird survey are species known to be common to the region including European starling, Tree swallow (*Tachycineta bicolor*), Common grackle (*Quiscalus quiscula*), Horned lark, Red-winged blackbird (*Agelaius phoeniceus*), Mourning dove (*Zenaida macroura*), and American robin (*Turdus migratorius*) (Table 5). As indicated in Table 5 these species collectively made up over 80% of all birds recorded during the spring and fall survey periods. The remaining passerines/landbirds observed were likewise common species that are typically found in disturbed and agricultural landscapes. These included species such as Brown-headed cowbird (*Molothrus ater*), Song sparrow (*Melospiza melodia*), American crow (*Corvus brachyrhynchos*), American goldfinch (*Carduelis tristis*), and Blue jay (*Cyanocitta cristata*) among others. Of note, very few wood-warblers or FIDS were recorded over the entire spring and fall survey. Of the 12,910 passerines/landbirds recorded only 19 individual warblers were observed.

Of the waterfowl recorded, Canada goose (*Branta canadensis*) and Mallard (*Anas platyrhynchos*) were generally the most abundant species. However, a relatively large concentration of 100 Tundra swan (*Cygnus columbianus*) were observed on a single occasion early in the spring period. Only three gull species and one county of Ohio listed tern species, the Common tern (*Sterna hirundo*), were recorded. The Common tern is a shore bird species that is considered endangered by Erie County, Ohio. While common along the shores of the Eastern Atlantic states, Common terns have only been observed nesting along the shores of Lake Erie within four counties of Ohio. The Common tern nests exclusively within sandy shores along large bodies of water, a habitat not found within the Project Area, thus the observed terns were likely migrants or pushed into the Project Area due to extreme weather and habitat conditions (observed flooded agricultural fields, dense fog, heavy rains and high winds). It is notable that the Common tern was only observed once in a flock of eighteen individuals, therefore it is unlikely that the Project Area serves as a “fall out” or routine migration “funnel” for this species.

The most abundant shorebird species observed over both the spring and fall periods was the Killdeer. Other shorebirds observed, although in much fewer numbers, included Semipalmated plover (*Charadrius semipalmatus*), Pectoral sandpiper (*Calidris melanotos*), and a few observations of American pipit (*Anthus rubescens*) and Wilson’s snipe (*Gallinago delicata*) during the fall.

Great blue heron (*Ardea herodias*) and Great egret (*Ardea alba*) were the two species of wading birds recorded. The Great blue heron was observed sporadically throughout the survey, while Great egret was observed on only one occasion. A complete record of all species recorded during the spring and fall diurnal raptor/bird survey is found in the electronic data file of Appendix C.

4.2.8 Non-Raptor Species Overall Temporal Distribution

The encounter rate, or individuals observed per hour of survey, was calculated for each two week Diurnal survey period during the spring and fall (Figure 12). The overall non-raptor species encounter rates were greater in the fall than during the spring 2011. Also, spring encounter rates were relatively consistent from March through the end of April, averaging between 20 and 30 individuals per hour, while fall encounter rates were relatively low in early September (~25 individuals per hour) and climbed to a peak of over 102 individuals per hour during early-mid October 2011. The overall bird encounter rate then declined at the end of October 2011.

4.2.9 Non-Raptor Species Composition & Relative Abundance

Passerines, the most abundant non-raptor species group overall (Tables 5 and 6), reflected consistent encounter rates in the spring between mid-March and mid-April (Figure 12). Passerine encounter rate then declined to approximately 10 individuals per hour during the last half of April. Passerines were more abundant during the fall period and had an encounter rate of over 20 individuals per hour in early September 2011 then rising to a peak encounter rate of over 90 birds per hour in early October 2011. Passerine encounter rate then declined in late October to an encounter rate of less than 40 individuals per hour.

Figure 13 shows the overall temporal distribution of Waterfowl, Shorebirds, Wading Birds, and Gulls observed during the diurnal/raptor migration surveys. Gulls and terns were most abundant in early spring (late March 2011) and late fall (late October 2011) with relatively little gull/tern activity in between these periods. Waterfowl were generally consistent throughout the survey with a minor peak in observations during early spring (late March 2011) and mid fall (early October 2011). The peak in mid fall is due to a relatively large number of Canada goose observed in early October 2011, while the peak in early spring is due to a relatively large combined number of Canada goose, Mallard, and Tundra swan recorded in late March 2011. Shorebirds were also observed in consistent numbers throughout the survey with a minor peak of activity in early April and again in early October 2011.

4.2.10 Non-Raptor Species Flight Height

As indicated in Table 7, the overall weighted average flight height was approximately 26 m. This overall weighted average flight height is within the lowest of the three height class categories (0 m – 40 m) used to record bird flight heights during the field investigation.

Table 7 indicates the overall number and percentage of birds that were observed flying between 0 m and 40 m, 40 m and 180 m, or greater than 180 m in height. As indicated in Table 8, the vast majority, over 91%, of all bird observations were either above 180 m or below 40 m. Of these, over 92% were observed flying below 40 m. While not exact, the proposed project turbine RSZ extends between a lower height of 50 m and an upper height of 150 m. Additionally, 180 birds were observed, but their flight height was unable to be determined.

4.3 Breeding Bird Survey

Tetra Tech biologists completed the BBS in May and June of 2011. Each of the 35 BBS points (Figure 5) were surveyed for 10 minutes each three times. Since the BBS is considered a discrete survey results are summarized for all observations recorded during the entire BBS in the following sections.

4.3.1 Overall & Relative Abundance of Species and Groups

A total of 2,063 breeding birds were recorded at the 35 BBS points during all three surveys (Figure 5). The largest percentage (93.80%) of the 2,063 birds observed were passerines and other landbirds (Table 9). Gulls and shorebirds had the next highest percentage at 4.22%. The remaining avian groups had lower counts and included waterfowl (0.78%), raptors (0.48%), unknown/unidentified birds (0.44%), and wading birds (0.34%).

Passerines/landbirds were further subdivided into related families or species groups. These included thrushes (*Turdidae*) and thrashers (*Mimidae*), blackbird (*icterid*) and corvids (*Corvidae*), sparrows (*Passeridae*), wrens (*Troglodytidae*), and swallows (*Hirundinidae*), cardinals and allies (*Cardinalidae*), finches (*Fringillidae*), flycatchers (*Tyrannidae*), starlings (*Sturnidae*) and larks (*Alaudidae*), and wood warblers (*Phylloscopus*) (Table 10). Blackbirds and corvids were the most abundant passerines/landbirds with 579 (~30%) of the total 2,063 birds observed during the BBS. These included primarily birds very common to the region including red-winged blackbird, common grackle, brown-headed cowbird, and American crow. The next most abundant passerine/landbird group was sparrows, wrens, and swallows collectively making up around 22% (*n* = 429) of the 2,063 birds observed. The most abundant species in this group included species common to the region such as song sparrow, house sparrow, chipping sparrow, barn swallow, and house wren. The other abundant group included thrushes and thrashers, making up approximately 20% of all birds recorded during the BBS with American robin and Gray catbird being most typical. European starling and Horned lark were also relatively abundant making up approximately 10% of all birds observed. Collectively these common groups consisted of over 80% of all individuals recorded.

The remaining passerine species groups, particularly the wood warblers, were considerably less abundant than those described above. Tetra Tech observed only 40 wood warbler individuals, throughout the entire BBS including 34 Yellow warblers (*Dendroica petechia*), one Chestnut-sided warbler (*Dendroica pensylvanica*), and five Black-and-white warblers (*Mniotilta varia*).

All bird groups and species observed are considered to be generally common to the region and many are often associated with disturbed and/or agricultural conditions. In addition, none of the birds recorded during the BBS were State of Ohio or Federally listed special status species.

4.4 Site Specific Bald Eagle Surveys

The 2011-2012 site specific Bald Eagle surveys were completed and Preliminary Bald Eagle survey results were provided in the *Stage 2 - Site Specific Bald Eagle Survey Preliminary Results (March-August 2011) and Risk Assessment Protocol Framework* dated February 10, 2012 and will be finalized in the pending *Stage 2 - Site Specific Bald Eagle Survey Report* that will be completed in July 2012.

4.5 Greater Sandhill Crane Migration Survey

A total of 12 day long diurnal Greater sandhill crane migration surveys were conducted between the two Greater sandhill crane diurnal sites (Figure 6) for a total of 5,040 minutes of observation and yielded no Greater sandhill crane observations.

A total of 4,800 minutes of observation were conducted over 13 days at the 40 Greater sandhill crane point counts from November 1 to December 15, 2011 without a Greater sandhill crane sighting (Figure 6). Thus, a total of 9,840 observation minutes were recorded for Greater sandhill crane surveys in the Project Area and none resulted in a Greater sandhill crane sighting (see electronic data file in Appendix C).

5.0 AVIAN SURVEY DISCUSSION

Tetra Tech successfully completed the proposed avian surveys as identified in the approved Study Plan during 2011 and 2012. As with the rest of the surrounding region, migratory birds were observed passing through the Project Area while traveling between breeding grounds (including Lake Erie) and wintering areas to the south. The Firelands/Lyme avian surveys documented a range of bird species including nine different species of raptors and over 70 non-raptor bird species including waterfowl, wading birds, passerines, and shorebirds. The vast majority of birds observed are considered to be common to the region and many are associated with agricultural habitat conditions such as American robin, Red-winged blackbird, Killdeer, European starlings, and Common grackles, or species known to winter and/or reside in the Ohio valley region including Northern harrier and American kestrel. Observations indicate that the Project Area was not used as a primary stopover or staging area by migrant wading birds, waterfowl, or shorebirds. Passerines were observed using the limited forest and scrub-shrub habitats in the Project Area during migration as well as raptors flying through the Project Area during the spring and fall migration periods. However, the relatively low abundance and diversity of these migration observations indicates that the Project Area did not act as a “funnel” during migration events.

Observations of unanticipated special status species were limited to only two incidental sightings of the Greater sandhill crane and one observation of Common terns. The Common tern is also the only State of Ohio listed non-raptor species recorded during the diurnal bird/raptor surveys. Common terns are considered endangered in Erie and three other counties with Lake Erie shorelines due to recorded nesting colonies by ODNR. The Common tern nests exclusively within sandy shores along large bodies of water, a habitat not found within the Project Area, thus the observed Common terns were likely migrants or pushed into the Project Area due to extreme weather and habitat conditions (observed flooded agricultural fields, dense fog, heavy rains and high winds). It is notable that the Common tern was only observed once in a flock of 18 individuals, therefore it is unlikely that the Project Area serves as a “fall out” or routine migration “funnel” for this species. A number of observations of the special status species the Northern harrier and Bald Eagle were recorded. Northern harrier was anticipated to be observed within the Project Area since they are a widespread species adapted to open grassland and croplands. The only area of concentration by the other observed listed species, the Bald Eagle, was the Huron River corridor in the southeast portion of the Lyme section of the Project Area. Bald Eagles will be discussed in greater detail in the pending *Stage 2 - Site Specific Bald Eagle Survey Report* that will be completed in July 2012.

5.1 Raptor Nest Searching & Monitoring

Tetra Tech biologists completed nest searches of the Project Area, the 10-mile Draft ECPG buffer, and the 2-mile ODNR wind guidelines buffer and only two Bald Eagle nests were observed within the Project Area (Figure 2). It is notable that Tetra Tech biologists observed breeding activity at only one of the two nests, and no Northern harrier nests were recorded within the Project Area. Therefore, it is unlikely that the Project Area is of critical breeding habitat for these State of Ohio listed raptor species. This is not unanticipated due to the conversion of over 98% of the Project Area to open cropland.

5.2 Diurnal Bird & Raptor Migration Survey

As would be expected in an inland agricultural landscape raptor species composition was dominated by common raptor species such as Turkey vulture and Red-tailed hawk. Raptors often seen in greater abundance at important migration sites such as Broad-winged and Sharp-shinned hawk were not prevalent in the Project Area. Non-raptor species observations were as expected for the agricultural habitat conditions of the Project Area.

5.2.1 Raptors

The overall abundance of raptors (863 individuals) and encounter rate of 2.45 individuals per hour in the Project Area was very low when compared with hawk watch data from sites that are known to be important raptor migration corridors or funnels. For example, the nearest hawk watch site (approximately 80 miles NNW) of the Project Area, located at Point Mouillee State Game Area on the western shore of Lake Erie (near Detroit, Michigan) typically has encounter rates in the hundreds if not thousands of birds per hour (Hawkcount 2012). Also, the average number of all raptors recorded during each season is significantly higher than the numbers recorded at Firelands/Lyme. These counts include an average of 160 Northern harrier observations per season (320 over both seasons) compared with 27 observed over combined spring and fall periods at Firelands/Lyme. Also, Broad-winged hawks are often seen in numbers over 80,000 during the fall period, while only seven were observed for the both the spring and fall in the Project Area.

Other regional hawk watch data such as the Presque Isle site near Erie, Pennsylvania (approximately 170 miles NE of the Project Area) indicate much higher encounter rates and total numbers of raptors than were observed at Firelands/Lyme. During spring 2011 a total of 11,356 raptors were observed at the Presque Isle Hawk Watch Site with an encounter rate of over 63 individuals per hour (Hawkcount 2012).

Encounter rates of individual bird species are likewise exceedingly low when compared with those from regional hawk watch sites. This includes very low encounter rates for Turkey vulture at Firelands/Lyme of between two and 3.5 individuals per hour when compared with encounter rates of several hundred individuals per hour at other hawk watch sites. The remaining raptors observed at Firelands/Lyme had encounter rates well below one individual per hour, which, again, is significantly less than encounter rates for these species at sites located along important known migration routes.

It is somewhat unusual that a greater number of raptors were observed in the spring than in the fall. However, this may be due to the site lacking the characteristics of a migration funnel or corridor; therefore, higher fall migration counts typically found at more important raptor migration sites were not observed at Firelands/Lyme. Another factor that may influence the similar spring and fall raptor numbers is that many of the raptors seen at the Firelands/Lyme may not have been migrants but rather resident birds. This is evidenced by the fact that it appeared that many of the birds recorded were seen multiple times by the field observers.

While the overall raptor numbers were very low in comparison to other known sites, the average flight height of all raptors combined was found to be within the range of the proposed turbine RSZ. This appears to be mostly due to the fact that the most abundant raptor species, Turkey vulture, had flight heights above 90 m, while several of the less abundant species had flight heights below 40 m. Raptor species that were observed to have a lower average flight height and that may avoid the lower limit of the RSZ included Northern harrier, Cooper's hawk, American kestrel, and Sharp-shinned hawk.

5.2.2 Non-Raptors

As indicated by the results, the species composition of the non-raptors was almost entirely passerines and other landbirds. Relatively few waterfowl, gulls, shorebirds, and wading birds were observed. Also, of the passerines/landbirds, the most abundant species were birds common to the region and typically found in disturbed and/or agricultural habitats. These included European starling, Common grackle, Red-winged blackbird, Mourning dove, and American robin. Also, results indicated that extremely low numbers of birds of special interest including wood warblers (FIDS species) and native grassland birds were recorded; however this is to be expected with the conversion of the Project Area to cropland.

Of note, even the most abundant species in the remaining bird groups/guilds were found to be many of the more common/ubiquitous species in the region. For example, the most abundant waterfowl were Canada goose and Mallard ducks, the most abundant shorebird was the widespread Killdeer, the most abundant wading bird was Great blue heron, and the most abundant gull by far was Ring-billed gull.

Interestingly, while the temporal abundance was relatively consistent across most periods; the fall season, particularly early October 2011 resulted in the greatest abundance of non-raptor diurnal birds. However, from a review of the data, it appears that this is due to an increase in the overall number of the same birds observed throughout the survey and is not due to a change in species composition. In other words, Tetra Tech observed a greater number of the same common species.

Flight heights were identified to be low and below the typical RSZ. Based on the species composition it is speculated that most of the non-raptors observed were not migrants, but resident birds. This would likely explain the low overall flight height, even during the migration season. Also, the relatively few birds that were found flying within the RSZ were Canada goose and Mallards.

5.3 Breeding Bird Survey

As would be expected in a typical agricultural landscape, the BBS indicated that individuals using the site during the breeding season are common species often associated with disturbed or agricultural landscapes. Very few forest interior or high quality grassland birds were detected and their numbers were relatively low. Based on these results it appears that the Project Area does not currently provide a great deal of breeding habitat for any special status birds with the notable exception of Bald Eagles.

Overall abundance of birds in the Project Area is likely typical for these common species inhabiting agricultural habitats in this region of Ohio.

5.4 Greater Sandhill Crane Migration Survey

The Greater sandhill crane is an Ohio listed endangered species. This species was listed as endangered in an effort to protect the resident Ohio population from extirpation. ODNR reports on Greater sandhill crane breeding activity and migration paths of individual radio tagged Greater sandhill cranes captured and tagged in Ohio can be found on the Wildlife population status report website (www.ohiodnr.com). According to the ODNR Sandhill crane status report, the 1990's and 2000's brought precipitous population inclines for the Greater sandhill crane largely attributed to higher reproduction rates of recorded nests.

Greater sandhill cranes were only observed twice as incidental sightings in the southern portion of the Lyme Project Area during the site specific Bald Eagle surveys (see Greater Sandhill Crane Point Count Locations 28 and 22, Figure 6). During each sighting a pair of Greater sandhill cranes was observed at 50 m - 150 m flight height and heading east and east-northeast. None of these individuals stopped or were observed foraging in the Project Area, nor were there any records of Greater sandhill crane breeding. These sightings suggest that the Project Area is not of critical importance to these wading birds. Greater sandhill cranes are typically sighted in Ohio along the Great Lake shorelines and only breed within open wetlands and bogs. While some wetlands do occur within the Project Area (<900 acres), they are small scattered portions that have been disturbed by farming and other agricultural practices. During designated species specific surveys no Sandhill cranes were observed approaching or within the Project Area. Tetra Tech biologists believe that the individuals sighted were migrants carried off course by extreme weather. Northwest Ohio and the state of Indiana have been documented migration corridors for Greater sandhill cranes via satellite tracking of individuals by ODNR (www.ohiodnr.com). The Project Area has not been a documented migration corridor for Greater sandhill cranes, however, a northwest to west high wind event or thunderstorm has the potential to detour migrating birds off of their routine migration course. As indicated by local weather station data there were thunderstorms and 11-18 m/s N to NNW winds twenty-four hours prior to and during the Greater sandhill crane sightings.

6.0 SUMMARY

Results of the diurnal raptor/bird and breeding bird surveys documented that the avian community in the Project Area is primarily composed of species common to the region and typically associated with disturbed and/or agricultural habitat conditions. This is evidenced by the fact that the data indicate that the most abundant raptors are Turkey vulture and Red-tailed hawk, while the most abundant non-raptor species recorded during both the migration and breeding seasons included European starling, Tree swallow, Common grackle, Horned lark, Red-winged blackbird, Mourning dove, and American robin. Also, other than Bald Eagle, Northern harrier and Common tern none of the remaining birds were listed as special status species. In addition, few wood-warblers (or FIDS species) and native grassland birds were observed during any surveys. This appears to indicate that the site is neither an important "fall out" location during migration nor an important nesting area for sensitive song birds during the breeding season.

Observations of unanticipated special status species were limited to only two incidental sightings of the Greater sandhill crane (during Bald Eagle surveys), one observation of Common terns and the presence of the Northern harriers and Bald Eagles throughout the diurnal field surveys. The Common tern is the only State of Ohio listed non-raptor species recorded during the diurnal bird/raptor surveys. Common terns are considered endangered in Erie and three other counties with Lake Erie shorelines due to recorded nesting colonies by ODNR. The Common tern nests exclusively within sandy shores along large bodies of water, a habitat not found within the Project Area, thus the observed terns were likely migrants or pushed into the Project Area due to extreme weather and habitat conditions (observed flooded agricultural fields, dense fog, heavy rains and high winds). It is notable that the Common tern was only observed once in a flock of eighteen individuals, therefore it is unlikely that the Project Area serves as a "fall out" or routine migration "funnel" for this species. A number of observations of the special status species the Northern harrier and Bald Eagle were recorded. Northern harrier was anticipated to be observed within the Project Area since they are a widespread species adapted to open grassland and croplands. However, no Northern harrier nests or fledglings were observed and the average number of observations for the Project Area was much lower than comparable study sites in the Great lakes region (see section 5.2.1). The only area of concentration for the other observed listed species, the Bald Eagle, was the Huron River corridor in the southeast portion of the Lyme section of the Project Area. Bald Eagles will be discussed in greater detail in the pending *Stage 2 - Site Specific Bald Eagle Survey Report* that will be completed in July 2012.

While the overall abundance of non-raptor species is likely average for the habitat conditions at Firelands/Lyme, the number and encounter rate for raptors was low, particularly when compared with regional hawk watch data from sites located along important migration routes. This indicates that the avian community at Firelands/Lyme has a typical abundance of common species associated with agricultural habitat but a comparatively low number of raptors, at least during migration.

Flight height for non-raptors was found to be low and primarily below the proposed project turbine RSZ, even during the migration season. This was determined to likely be due to the fact that most non-raptors observed are likely resident birds with very few being actual migrants. The flight height for raptors was found to be relatively high and within the typical RSZ. This result was not unexpected given the behavioral trait of most raptors to soar while foraging or making seasonal or daily movements. While the more common and most abundant raptors such as Turkey vulture and Red-tailed hawk had flight heights within the RSZ, some of the less common and abundant species such as Northern harrier, Cooper's hawk, American kestrel, and Sharp-shinned hawk had average flight heights either below or at the lower end of the RSZ.

Based on the combined results of the raptor nest search, Greater sandhill crane survey, diurnal raptor/bird migration survey, and breeding bird survey the Project Area does not appear to be of great importance to special status or migratory birds. However, the Project Area does provide habitat for the Bald Eagle, a State of Ohio protected species, along with a moderate number of some of the regions more common bird species. Survey results for Bald Eagles are reported and discussed in detail in the *Stage 2 - Site Specific Bald Eagle Survey Preliminary Results (March-August 2011) and Risk Assessment Protocol Framework* dated February 10, 2012 and will be finalized in the pending *Stage 2 - Site Specific Bald Eagle Survey Report* that will be completed in July 2012

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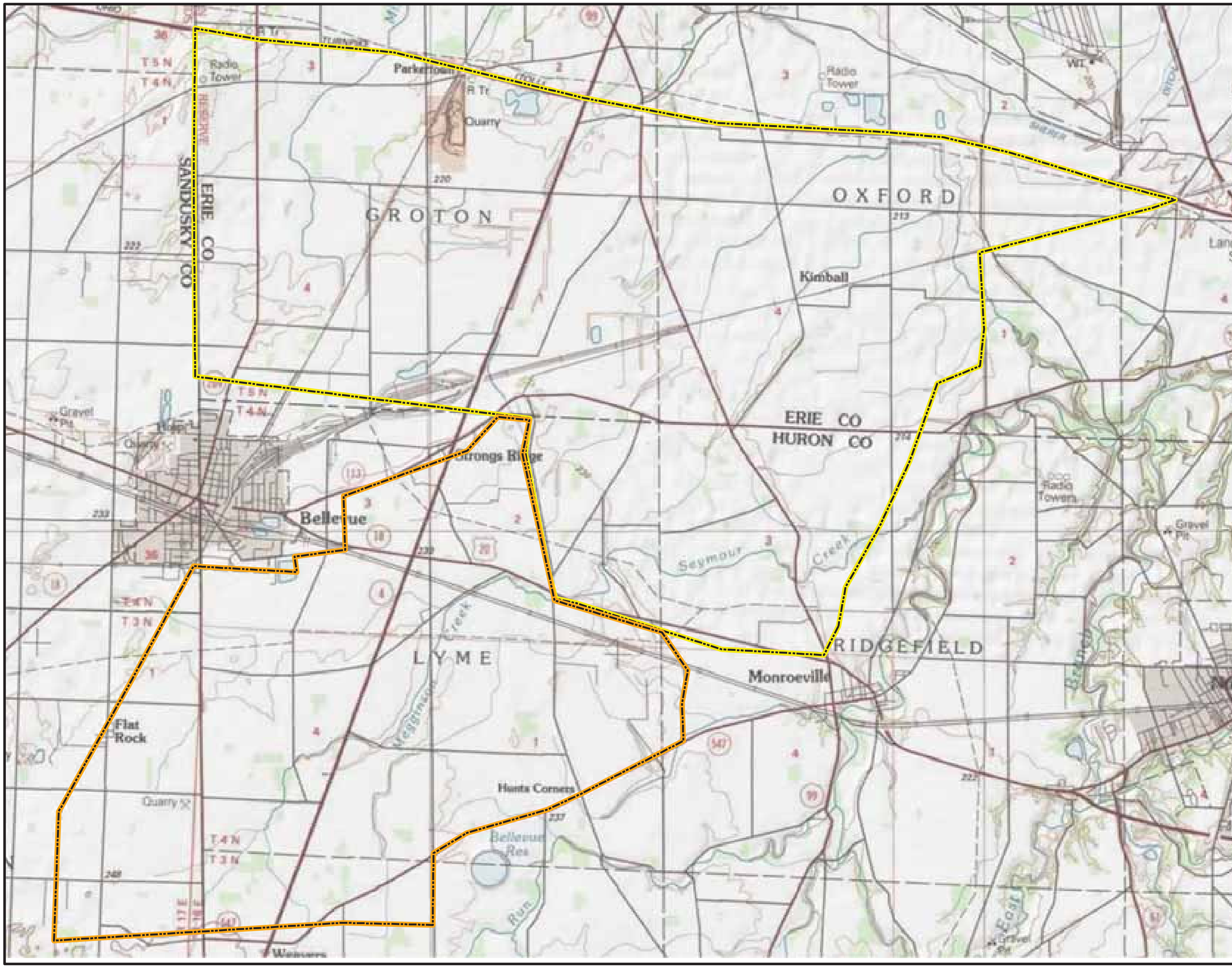
FIGURES



JUWI WIND
FIRELANDS AND LYME PROJECT
ERIE, HURON, AND SENECA COUNTIES, OHIO

FIGURE1
SITE LOCATION MAP

TETRA TECH

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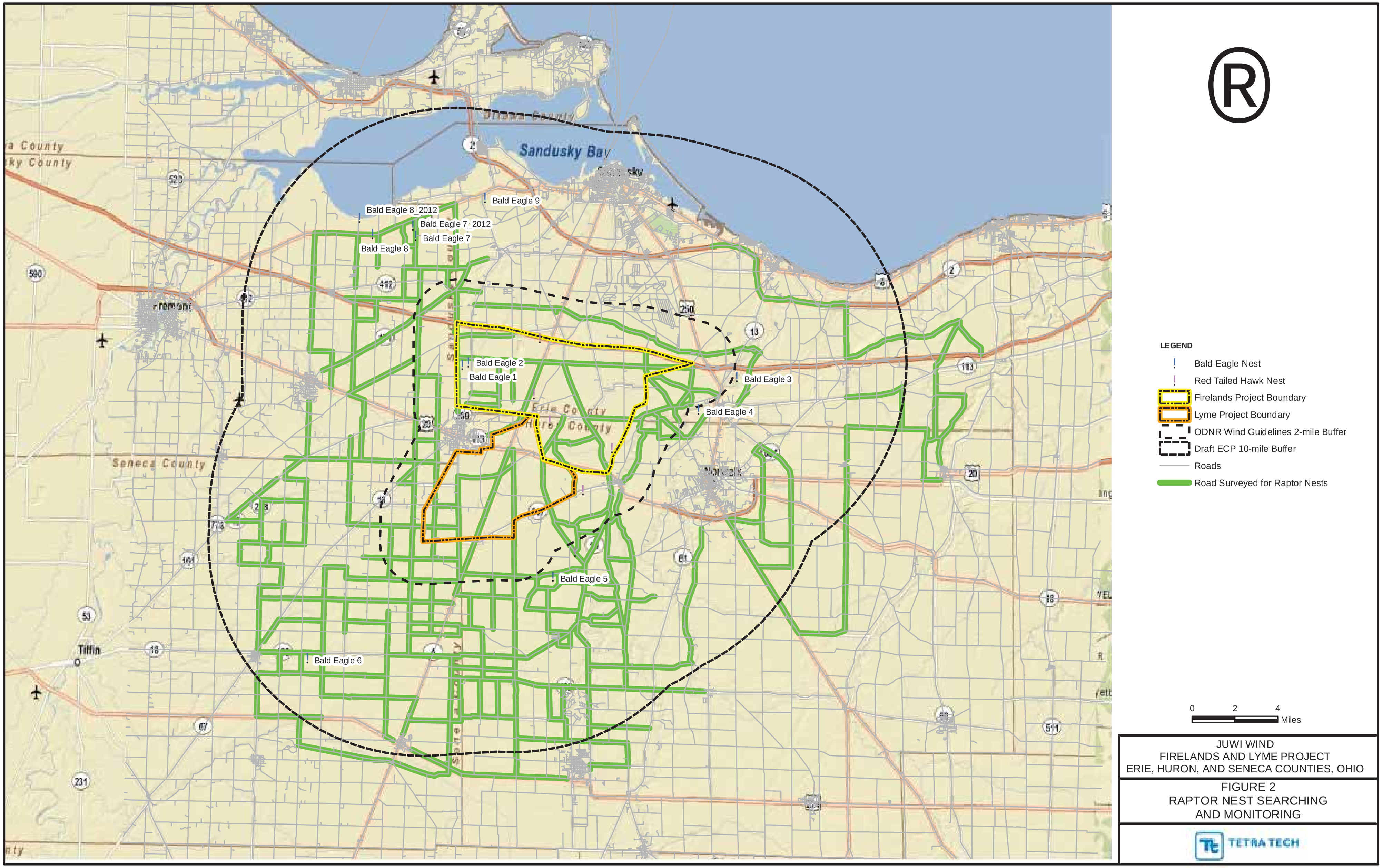
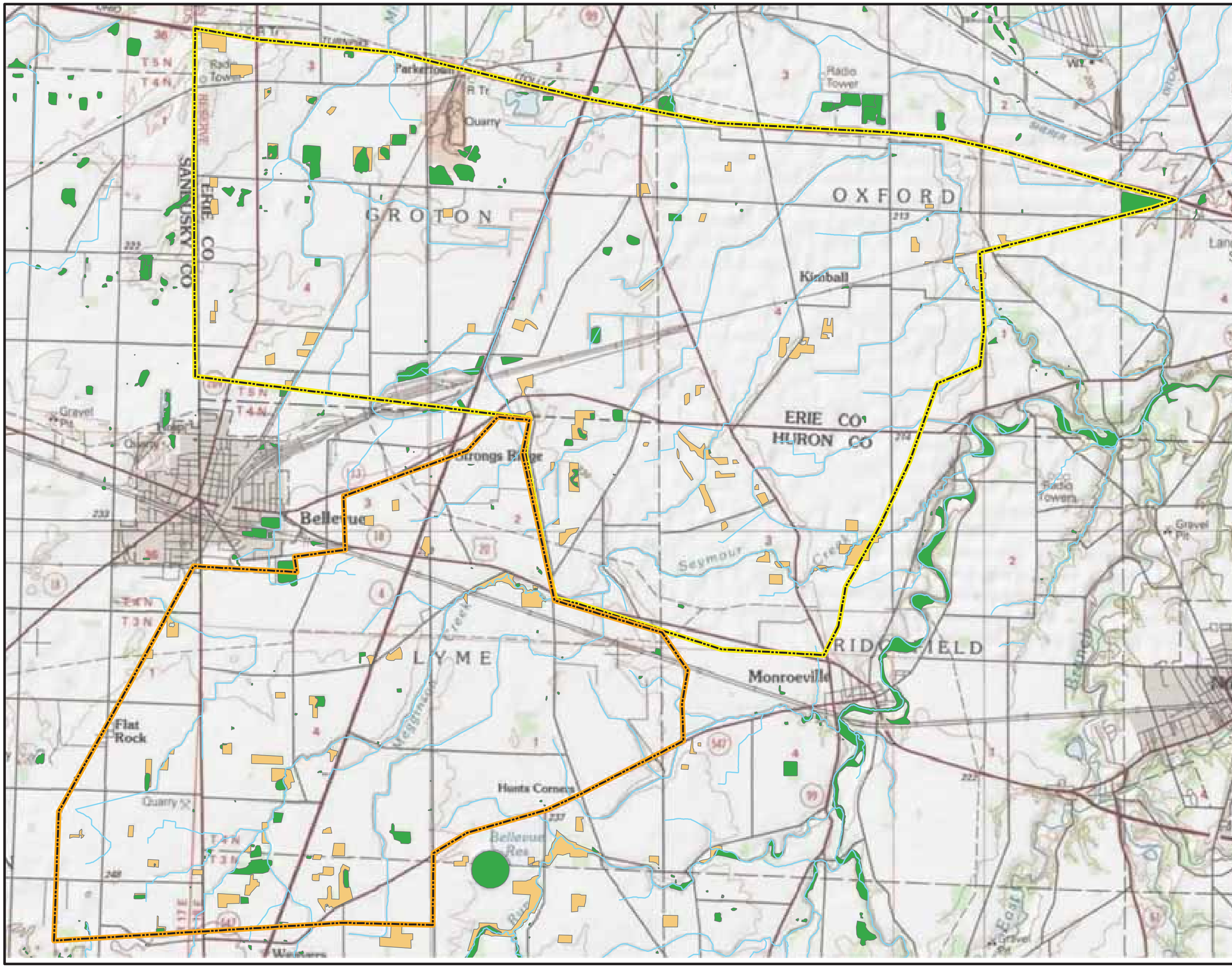


JUWI WIND
FIRELANDS AND LYME PROJECT
ERIE, HURON, AND SENECA COUNTIES, OHIO

FIGURE 2
RAPTOR NEST SEARCHING
AND MONITORING

TETRA TECH

Path: S:\CADD\MJ\JUWI\Firelands\005_Eagle\Firelands_Lyme_Avian_Fig2_RaptorNest.mxd Author: joel.peters Date: 7/20/2012



LEGEND
- Lyme Project Boundary
- Firelands Project Boundary
- National Hyrdrography Dataset
- National Wetland Inventory
- Forested Habitat

0 0.75 1.5 Miles

JUWI WIND
FIRELANDS AND LYME PROJECT
ERIE, HURON, AND SENECA COUNTIES, OHIO

FIGURE 3
PROJECT AREA EXISTING CONDITIONS

TETRA TECH

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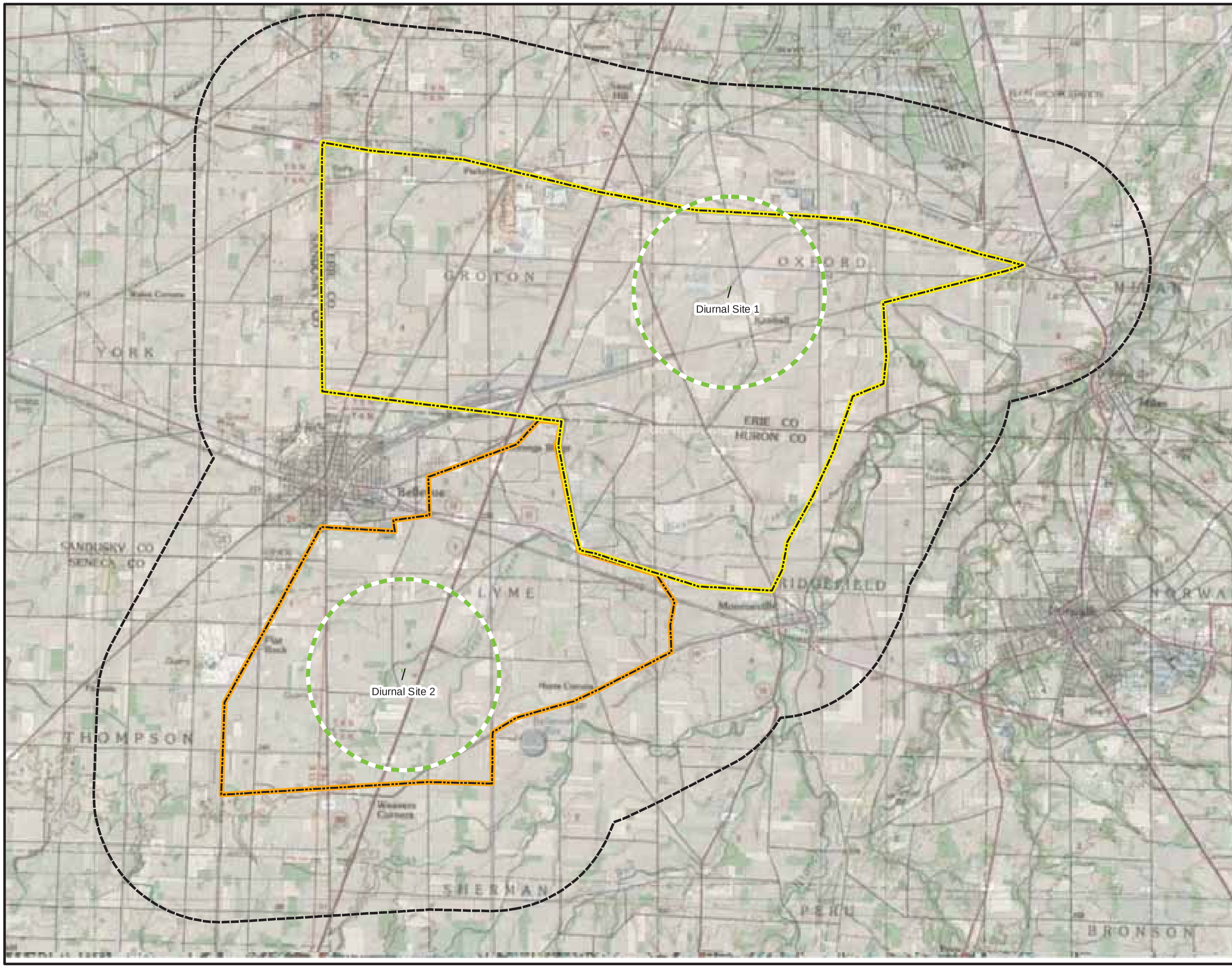


LEGEND

Diurnal Raptor and Bird Survey Location
1.5 Mile Buffer
Firelands Project Boundary
Lyme Project Boundary
ODNR Wind Guidelines 2-mile Buffer

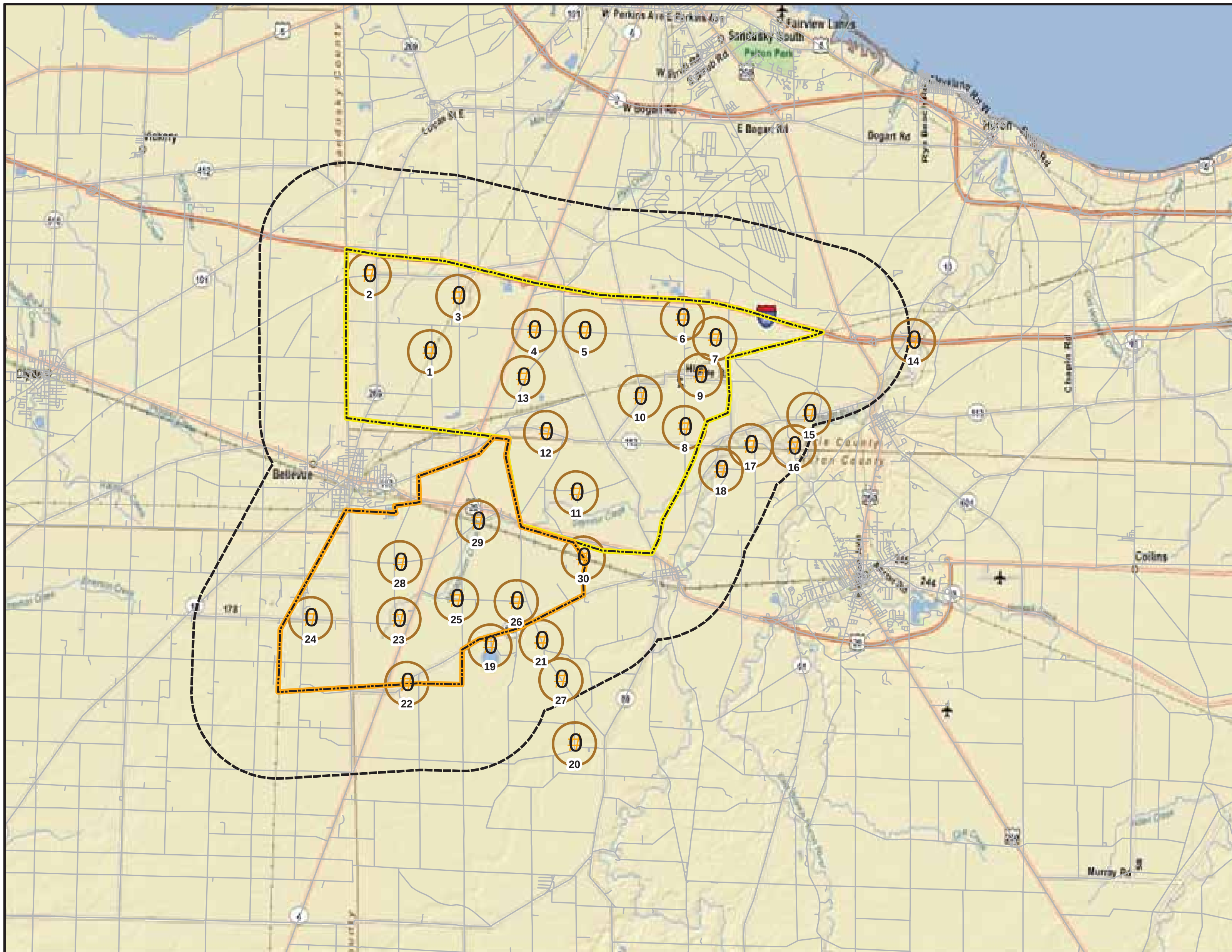
0 0.75 1.5 Miles

JUWI WIND
FIRELANDS AND LYME PROJECT
ERIE, HURON, AND SENECA COUNTIES, OHIO

FIGURE 4
DIURNAL RAPTOR AND BIRD
MIGRATION SURVEYS

TETRA TECH

Path: C:\JUWI\Firelands\Firelands_Lyme_Avian_Fig3_DiurnalBirdRaptorMigrationSurveys.mxd Author: joel.peters Date: 5/11/2012



LEGEND

- Breeding Bird Point Count Locations
- Lyme Project Boundary
- Firelands Project Boundary
- Roads
- 800-Meter Buffer
- Project Area 2-mile Buffer

0 1 2 Miles

JUWI WIND
FIRELANDS AND LYME PROJECT
ERIE, HURON, AND SENECA COUNTIES, OHIO

FIGURE 5
BREEDING BIRD POINT COUNT LOCATIONS

TETRA TECH

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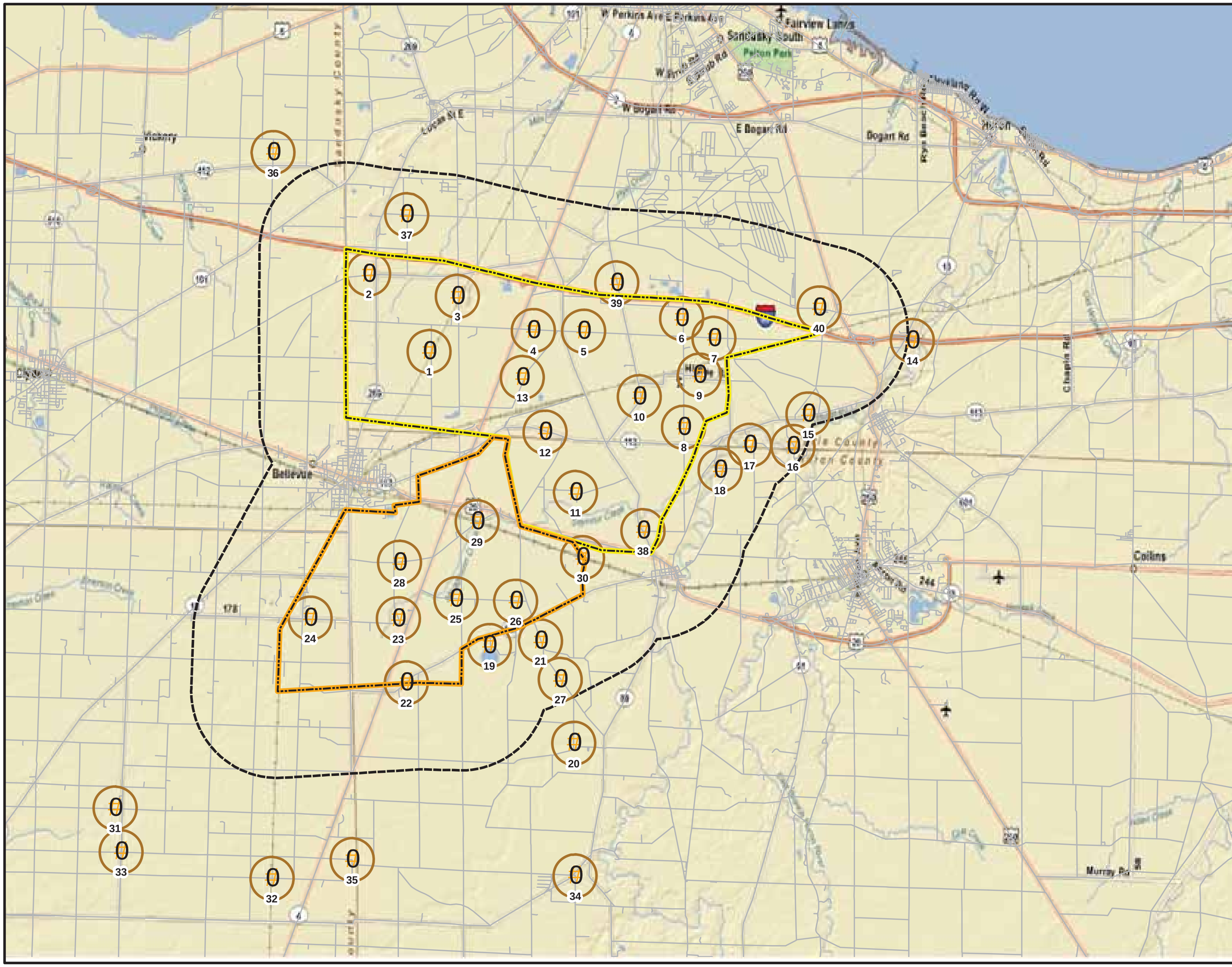


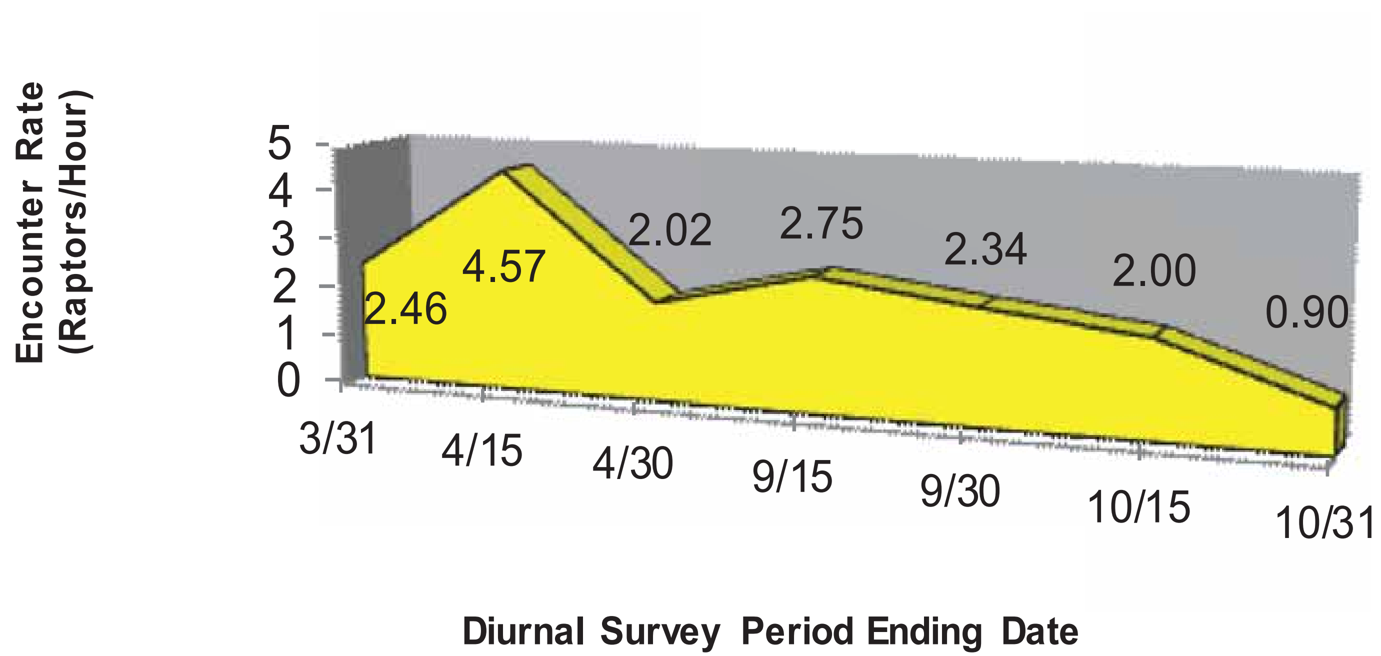
JUWI WIND
FIRELANDS AND LYME PROJECT
ERIE, HURON, AND SENECA COUNTIES, OHIO

FIGURE 6
SANDHILL CRANE POINT COUNT LOCATIONS

TETRA TECH

Path: S:\CADD\MJ\JUWI\Firelands\005_Eagle\Firelands_Lyme_Avian_Fig4_SandhillCrane_PointCountLocations.mxd Author: joel.peters Date: 4/18/2012

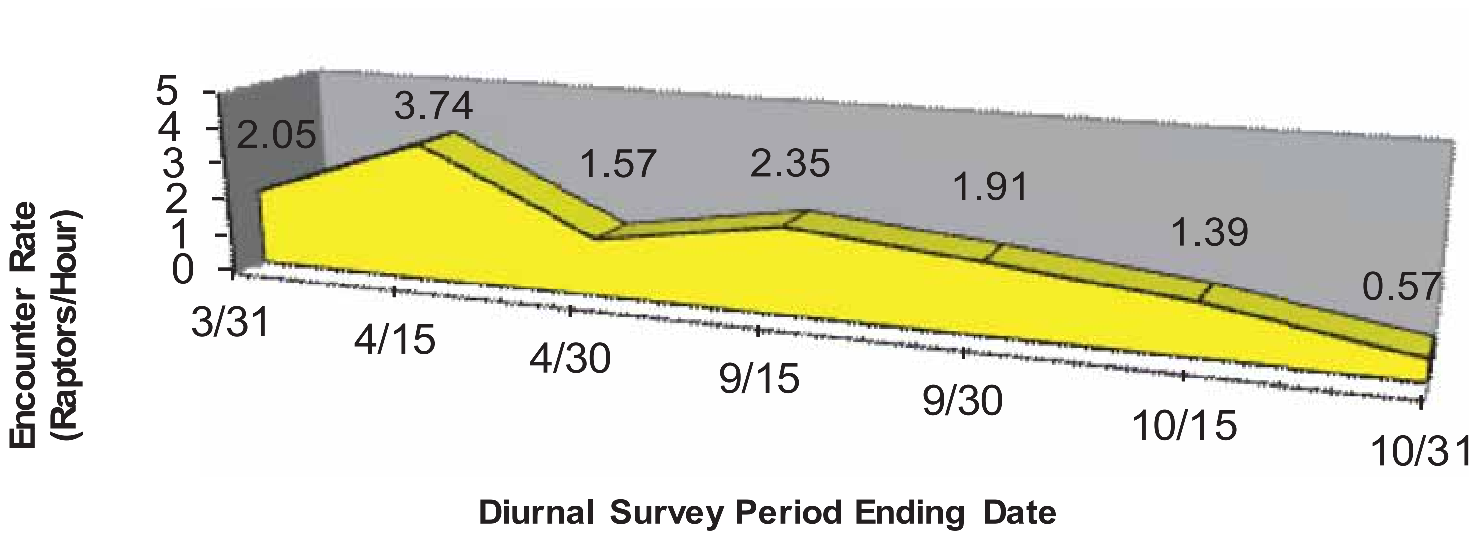
Figure 7 - Overall Temporal Distribution of Encounter Rates by All Raptor Species



Notes:

1) Spring Diurnal Migration Surveys were conducted from March 15 – April 30, 2011
2) Fall Diurnal migration Surveys were conducted from September 1 – October 31, 2011
3) No survey effort was conducted outside of the Spring and Fall Diurnal migration survey periods

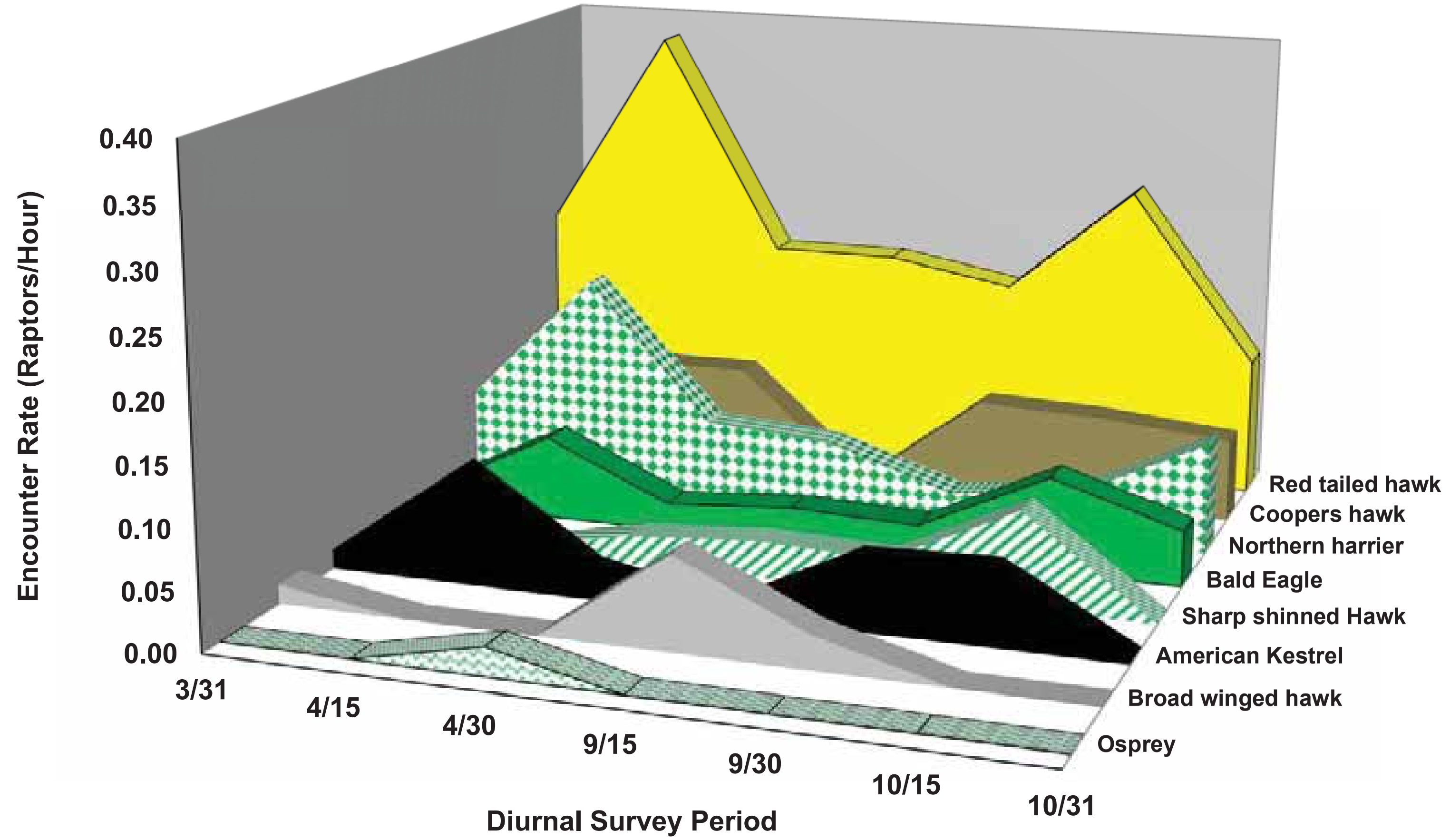
Figure 8 – Overall Temporal Distribution of Turkey Vulture Encounter Rate



Notes:

1) Spring Diurnal Migration Surveys were conducted from March 15 – April 30, 2011
2) Fall Diurnal migration Surveys were conducted from September 1 – October 31, 2011
3) No survey effort was conducted outside of the Spring and Fall Diurnal migration survey periods

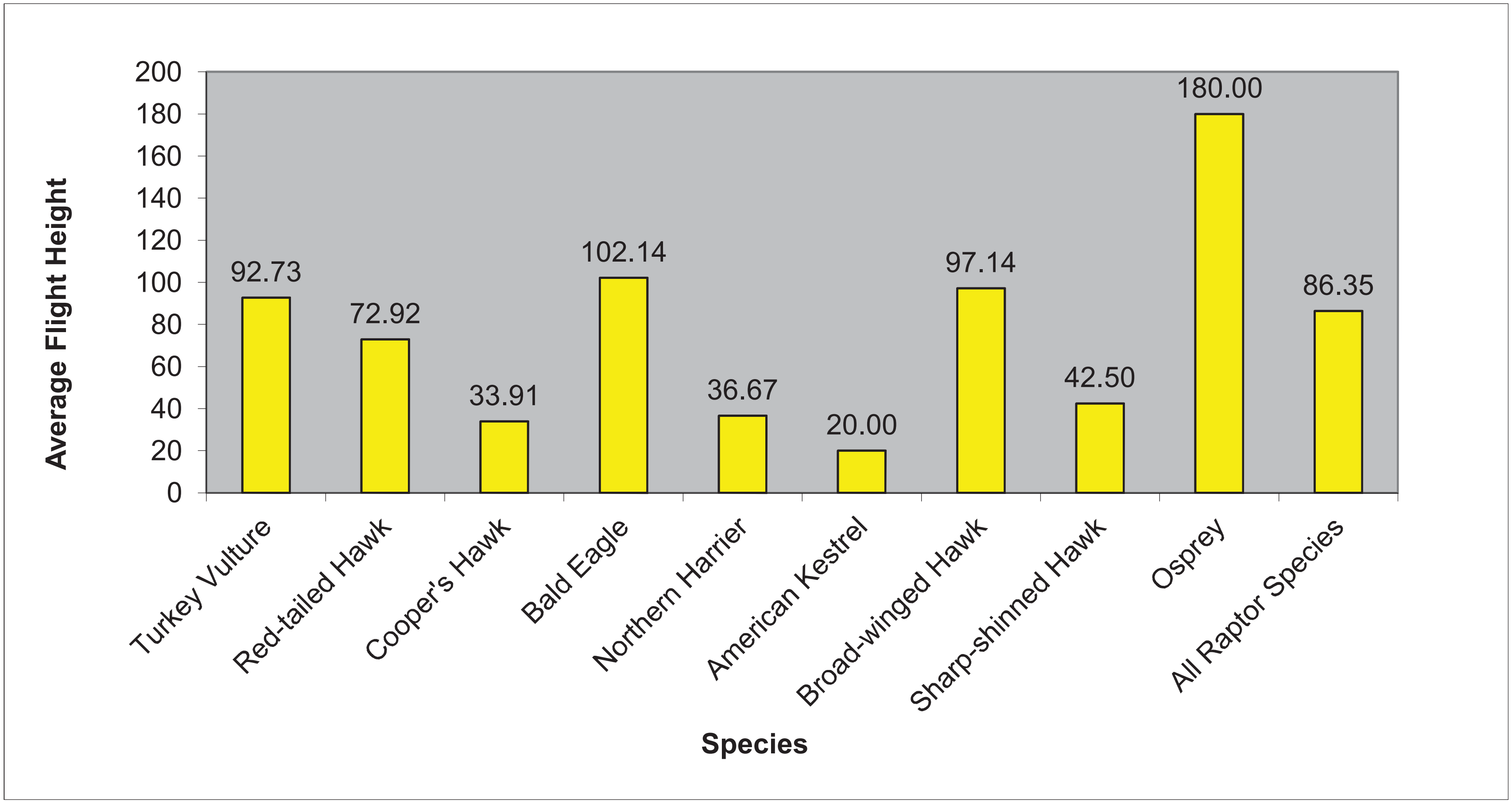
Figure 9 - Temporal Distribution of Encounter Rates by Raptor Species



Notes:

1) Spring Diurnal Migration Surveys were conducted from March 15 – April 30, 2011
2) Fall Diurnal migration Surveys were conducted from September 1 – October 31, 2011
3) No survey effort was conducted outside of the Spring and Fall Diurnal migration survey periods

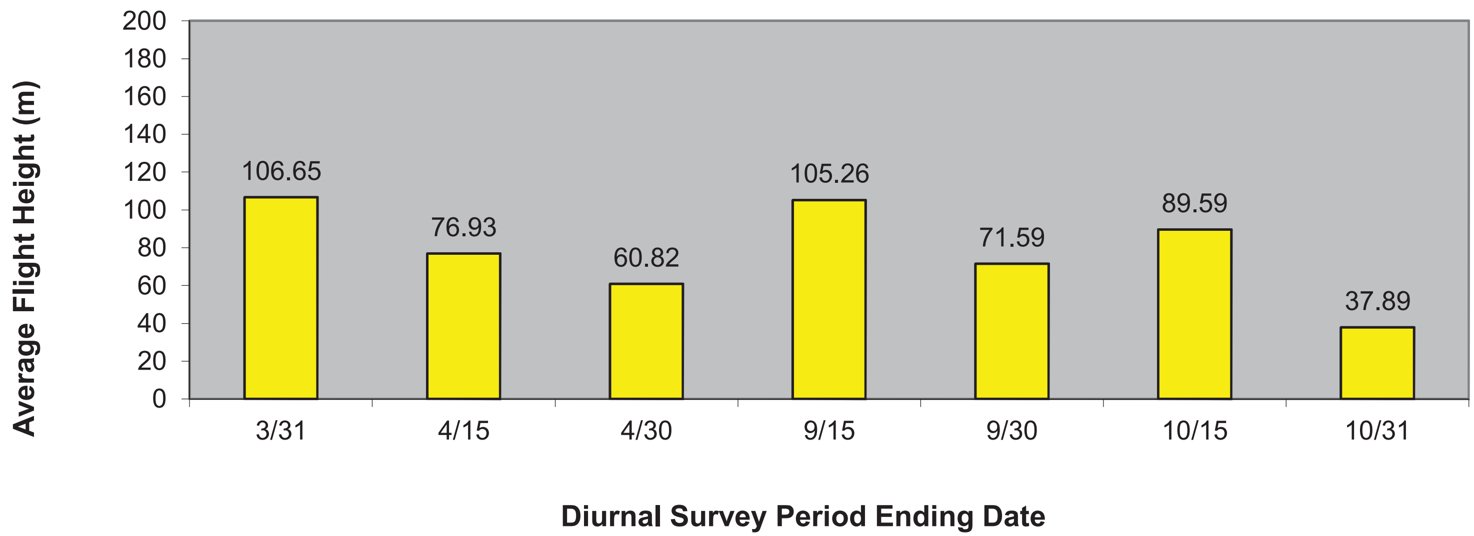
Figure 10 – Diurnal Raptor/Bird Migration Survey Raptor Weighted Average Flight Height



Notes:

1) The rotor swept zone (RSZ) is assumed to be between 50 m to 150 m above the ground surface.

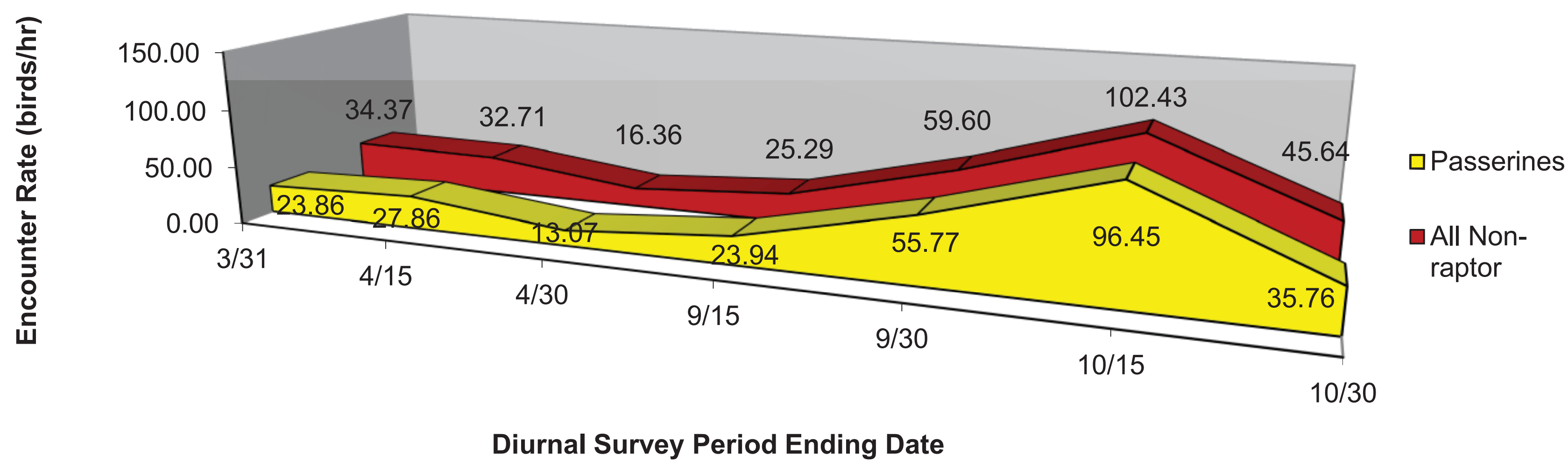
Figure 11 – Raptor Average Flight Height by Diurnal Survey Period



Notes:

1) Spring Diurnal Migration Surveys were conducted from March 15 – April 30, 2011
2) Fall Diurnal migration Surveys were conducted from September 1 – October 31, 2011
3) No survey effort was conducted outside of the Spring and Fall Diurnal migration survey periods
4) The rotor swept zone (RSZ) is assumed to be between 50 m to 150 m above the ground surface.

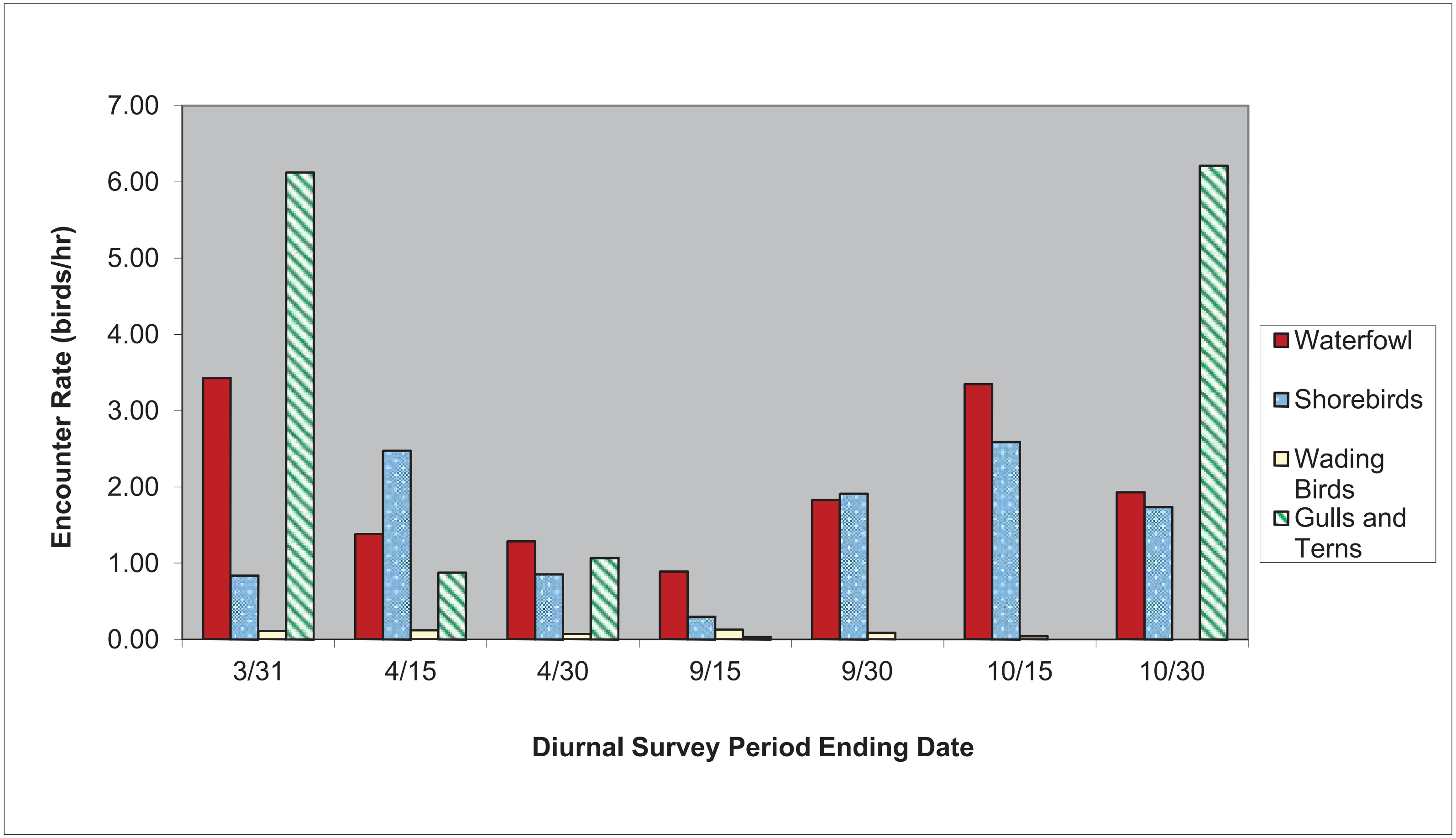
Figure 12 - Overall Temporal Distribution of Passerine and All Non-Raptor Species



Notes:

1) Spring Diurnal Migration Surveys were conducted from March 15 – April 30, 2011
2) Fall Diurnal migration Surveys were conducted from September 1 – October 31, 2011
3) No survey effort was conducted outside of the Spring and Fall Diurnal migration survey periods

Figure 13 – Overall Temporal Distribution of Waterfowl, Shorebirds, Wading Birds, and Gulls



Notes:

1) Spring Diurnal Migration Surveys were conducted from March 15 – April 30, 2011
2) Fall Diurnal migration Surveys were conducted from September 1 – October 31, 2011
3) No survey effort was conducted outside of the Spring and Fall Diurnal migration survey periods

TABLES

Notes & Reference Codes

Flight Heading	Degrees	Direction
N	0	North
NNE	23	North North East
NE	45	North East
ENE	68	East North East
E	90	East
ESE	113	East South East
SE	135	South East
SSE	158	South South East
S	180	South
SSW	203	South South West
SW	225	South West
WSW	248	West South West
W	270	West
WNW	293	West North West
NW	315	North West
NNW	338	North North West

Abbreviation	Notes
RSZ	Rotor Swept Zone (approximately 50 to 150 meters above the ground surface)
m	Meters
N/A	Not Applicable
#	Number
-	No observation or comment or unable to be determined

Table 1 – Overall Diurnal Raptor/Bird Survey

Raptors Observed		Spring & Fall Two-Week Diurnal Survey Periods by Ending Date							
Species	**Genus/Species**	**31-Mar-11**	**15-Apr-11**	**30-Apr-11**	**15-Sep-11**	**30-Sep-11**	**15-Oct-11**	**31-Oct-11**	**Total**
Turkey Vulture	*Cathartes aura*	129	157	66	148	67	68	24	659
Red-Tailed Hawk	*Buteo jamaicensis*	13	16	8	12	6	13	5	73
Bald Eagle	*Haliaeetus leucocephalus*	1	3	1	2	1	4	2	14
American Kestrel	*Falco sparverius*	1	4	1	0	2	3	0	11
Broad-Winged Hawk	*Buteo platypterus*	1	0	0	5	1	0	0	7
Cooper's Hawk	*Accipiter cooperii*	5	4	4	0	3	4	3	23
Northern Harrier	*Circus cyaneus*	5	8	3	4	1	2	4	27
Osprey	*Pandion haliaetus*	0	0	1	0	0	0	0	1
Sharp-Shinned Hawk	*Accipiter striatus*	0	0	1	2	1	4	0	8
Total (#)		155	192	85	173	82	98	38	823
Diurnal Survey Period (Hours)		63	42	42	63	35	49	42	336
Encounter Rate (# / Hours)		2.5	4.6	2.0	2.7	2.3	2.0	0.9	2.4

Table 2 – Diurnal Raptor/Bird Survey Encounter Rates

Raptor Species		Spring & Fall Two-Week Diurnal Survey Periods by Ending Date								
Species	**Genus/Species**	**31-Mar-11**	**15-Apr-11**	**30-Apr-11**	**Spring Average**	**15-Sep-11**	**30-Sep-11**	**15-Oct-11**	**31-Oct-11**	**Fall Average**
Turkey Vulture	*Cathartes aura*	2.05	3.74	1.57	2.45	2.35	1.91	1.39	0.57	1.56
Red-Tailed Hawk	*Buteo jamaicensis*	0.21	0.38	0.19	0.26	0.19	0.17	0.27	0.12	0.19
Bald Eagle	*Haliaeetus leucocephalus*	0.02	0.07	0.02	0.04	0.03	0.03	0.08	0.05	0.05
American Kestrel	*Falco sparverius*	0.02	0.1	0.02	0.05	0	0.06	0.06	0	0.03
Broad-Winged Hawk	*Buteo platypterus*	0.02	0	0	0.01	0.08	0.03	0	0	0.03
Cooper's Hawk	*Accipiter cooperii*	0.08	0.1	0.1	0.09	0	0.09	0.08	0.07	0.06
Northern Harrier	*Circus cyaneus*	0.08	0.19	0.07	0.11	0.06	0.03	0.04	0.1	0.06
Osprey	*Pandion haliaetus*	0	0	0.02	0.01	0	0	0	0	0.00
Sharp-Shinned Hawk	*Accipiter striatus*	0	0	0.02	0.01	0.03	0.03	0.08	0	0.04

Table 3 – Diurnal Raptor/Bird Survey Direction of Flight

Cardinal Direction	Percent of Raptor Flights in Spring	Percent of Raptor Flights in Fall
N	12.98%	9.92%
NE	8.78%	8.40%
E	17.94%	9.92%
SE	11.07%	8.40%
S	21.37%	17.56%
SW	4.58%	7.25%
W	10.69%	13.36%
NW	11.83%	4.58%

Table 4 – Diurnal Raptor/Bird Survey Species Composition and Relative Abundance of Non-Raptor Species Groups

Species Group/Guild	Genus	Species Richness	Total Count of Individuals in Species Group	Percentage of Total Count/Relative Abundance
Waterfowl & Loon	*Aneriformes*	9	693	4.67%
Passerines	*Passeriformes*	55	12,910	86.99%
Shorebirds	*Charadriiformes*	5	479	3.23%
Wading Birds	*Charadriiformes*	2	28	0.19%
Gulls And Terns	*Laridae*	3	731	4.93%
All Groups	-	74	14,841	100%

Table 5 – Diurnal Raptor/Bird Survey Passerine/Landbird Species Composition and Relative Abundance

Most Abundant Passerine/Landbird Species	Genus/species	Total Bird Count	Percentage of Total Count/Relative Abundance
European Starling	*Sturnus vulgaris*	3,417	26.41%
Tree Swallow	*Tachycineta bicolor*	2,330	18.01%
Common Grackle	*Quiscalus quiscula*	1,480	11.44%
Horned Lark	*Eremophila alpestris*	1,341	10.37%
Red-Winged Blackbird	*Agelaius phoeniceus*	837	6.47%
Mourning Dove	*Zenaida macroura*	790	6.11%
American Robin	*Turdus migratorius*	570	4.41%
All Warbler Species Combined	*Phylloscopus*	19	0.12%
Total	--	10,784	83.34%

Table 6 – Diurnal Raptor/Bird Survey Non-Raptor Species Encounter Rates

Species/Group	Genus/ species	Count	Encounter Rate (Species Count/Diurnal Survey Period Hours)
European Starling	*Sturnus vulgaris*	3,417	26.47
Tree Swallow	*Tachycineta bicolor*	2,330	18.05
Common Grackle	*Quiscalus quiscula*	1,480	11.46
Horned Lark	*Eremophila alpestris*	1,341	10.39
Red-winged Blackbird	*Agelaius phoeniceus*	837	6.48
Dove	*Zenaida macroura*	790	6.12
American Robin	*Turdus migratorius*	570	4.42
Brown Headed Cowbird	*Molothrus ater*	398	3.08
Bank Swallow	*Riparia riparia*	354	2.74
Song Sparrow	*Melospiza melodia*	286	2.22
American Crow	*Corvus brachyrhynchos*	205	1.59
American Goldfinch	*Carduelis tristis*	204	1.58
Blue Jay	*Cyanocitta cristata*	164	1.27
Barn Swallow	*Hirundo rustica*	27	0.21
Warblers	*Phylloscopus*	19	0.15

Table 7 – Diurnal Raptor/Bird Migration Survey – Non-Raptor Species Flight Height Observations

Flight Height Category	0-40 M	40-180 M	>180 M	Subtotal	Unidentified	Total
Count	13,592	1,050	19	14,661	180	14,841
Percent	92.71%	7.16%	0.13%	-	**Weighted Average**	26.65 m

Table 8 – Diurnal Raptor/Bird Survey Non-Raptor Species Rotor Swept Zone Observations

	Individuals Within RSZ	Individuals Above or Below RSZ	Total
Non-Raptor Species Observations	1,230	13,611	14,841
Percentage	8.29%	91.71%	100%

Table 9 – Breeding Bird Survey Species by Group

Species Group/Guild	Species Richness (Count of Individuals within Species Group)	Total Count of Individuals in Species Group	Percentage of Total Count/Relative Abundance
Passerines	55	1,935	93.8%
Shorebirds And Gulls	5	87	4.22%
Waterfowl	9	15	0.78%
Raptors	3	10	0.48%
Unknown	Not Applicable	9	0.44%
Wading Birds	2	7	0.34%
All Groups	74	2,063	100%

Table 10 - Breeding Bird Survey Species Abundance

Species Group/Guild	Species Richness (Count of Individuals within Species Group)	Percentage of Total Count/Relative Abundance
Blackbirds and Corvids	579	29.92%
Sparrows, Wrens, and Swallows	429	22.17%
Thrushes and Thrashers	380	19.64%
Starlings and Larks	192	9.92%
Cardinals and Allies	83	4.29%
Finches	73	3.77%
Flycatchers	34	1.76%
Wood Warblers	40	2.07%
Miscellaneous	126	6.51%
Total	1,936	100%

Appendix A

AGENCY CORRESPONDENCE & APPROVALS

Ohio Department of Natural Resources

TED STRICKLAND, GOVERNOR

SEAN D. LOGAN, DIRECTOR

Division of Wildlife
James A. Marshall, Acting Chief
2045 Morse Rd., Bldg. G
Columbus, OH 43229-6693
Phone: (614) 265-6300

September 30, 2010

To all interested parties,

Based upon the revised project boundary map received on 29 September 2010 and site visit conducted on 7 November 2008, the Ohio Department of Natural Resources Division of Wildlife (DOW) has prepared these survey recommendations for JW Great Lake's proposed wind energy project located in Huron and Erie Counties. The DOW has determined that this proposed facility would be classified as a "moderate" effort site under the current monitoring protocols based upon the location and land-use practices (Fig. 1).

The table below was created based upon the project maps provided and summarizes the types and level of effort recommended by the DOW. Results from these studies will help the Department of Natural Resources assess the potential impact these turbines may pose, and influence our recommendations to the Ohio Power Siting Board. Monitoring should follow those criteria listed within the "On-shore Bird and Bat Pre-Construction Monitoring Protocol for Commercial Wind Energy Facilities in Ohio."

For additional ODNR comments, including information on the potential presence of threatened and endangered species within or adjacent to your project area, please contact Brian Mitch at (614) 265-6378 or brian.mitch@dnr.state.oh.us

	Project
Survey type	JWGL Firelands
Breeding bird	Breeding bird surveys should be conducted at all sites. The number of survey points may be based on the amount of available habitat, or twice the maximum number of turbines proposed for the site. Because agricultural land is not considered to be suitable nesting habitat for most species of bird, turbines placed within these types of habitat are exempt of this recommendation.
Raptor nest searches	Nest searches should occur on, and within a 1-mile buffer of the proposed facility.
Raptor nest monitoring	There is at least one nest for a protected species of raptor, a bald eagle nest, on or within 2-miles of the project area. This nest should be monitored in order to

	establish patterns of activity. This information will be used to recommend micro-siting of turbines in such a manner to reduce the likelihood of impacting this state and federally protected species. Any additional discovered during the raptor nest searches should also be monitored.
Bat acoustic monitoring	Monitoring should be conducted at all meteorological towers. As a signatory to the Cooperative Agreement, JWGL may opt not to conduct acoustic monitoring at this site. In exchange, JWGL agrees to not operate turbines when wind speeds are ≤4 m/s (as measured within the rotor swept area) from dusk to dawn, 1 July to 31 October for the life of the facility in order to minimize the likelihood of impacts to bats.
Passerine migration (# of survey points)	Waived
Diurnal bird/raptor migration (# of survey point)	1
Sandhill crane migration (same points as raptor migration)	N/S
Owl playback survey points	N/S
Barn owl surveys	N/S
Bat mist-netting (# of survey points)	5
Nocturnal marsh bird survey points	N/S
Waterfowl survey points	N/S
Shorebird migration points	N/S
Radar monitoring locations	N/S

NS = Not required based on the lack of suitable habitat.

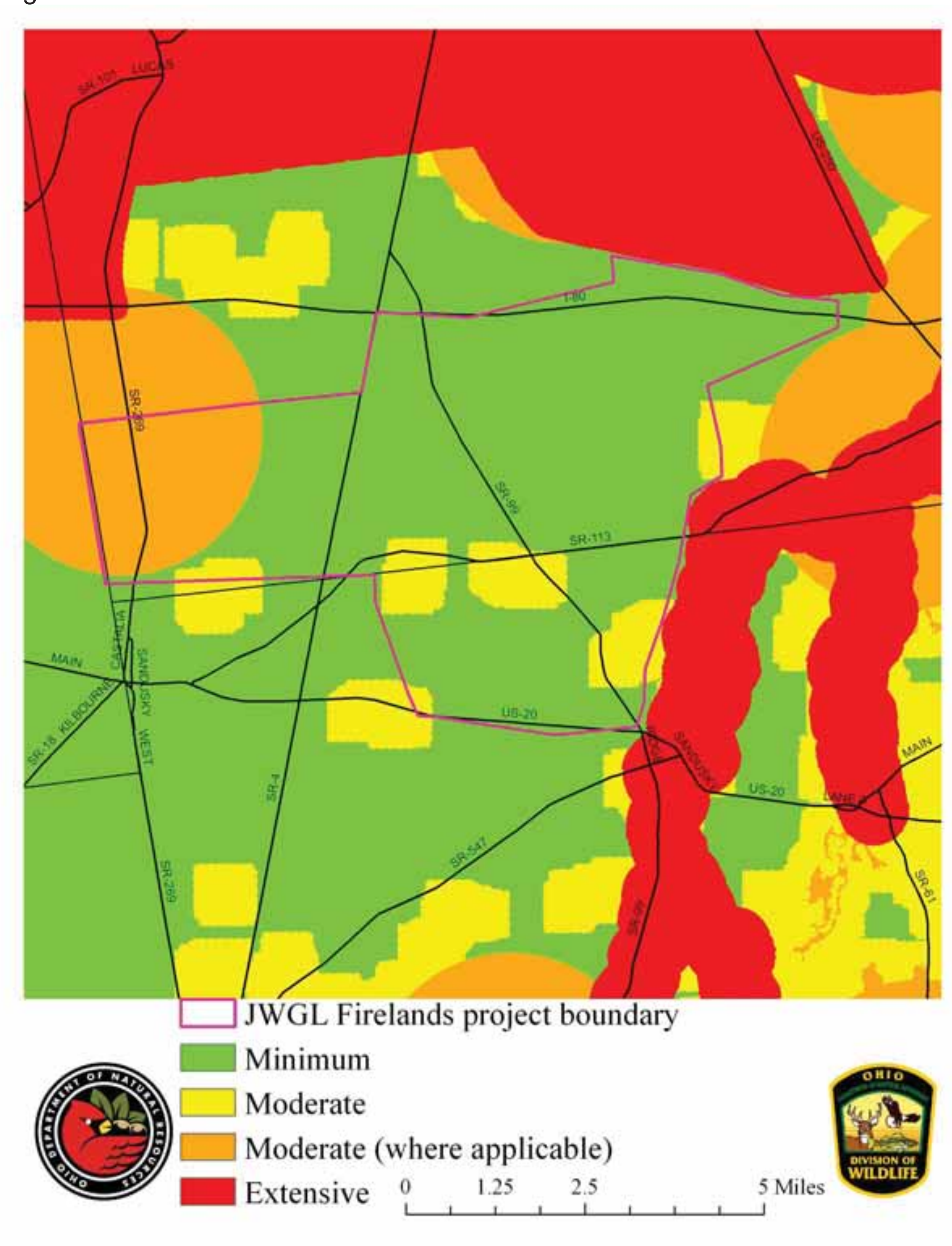
If you have any questions, please feel free to contact me.

Keith Lott, Wind Energy Wildlife Biologist

Old Woman Creek Nat'l Estuarine Research Reserve and State Nature Preserve
Ohio Division of Wildlife
2514 Cleveland Road East
Huron, OH 44839
Office phone: 419-433-4601
Cell: 419-602-3141
Fax: 419-433-2851

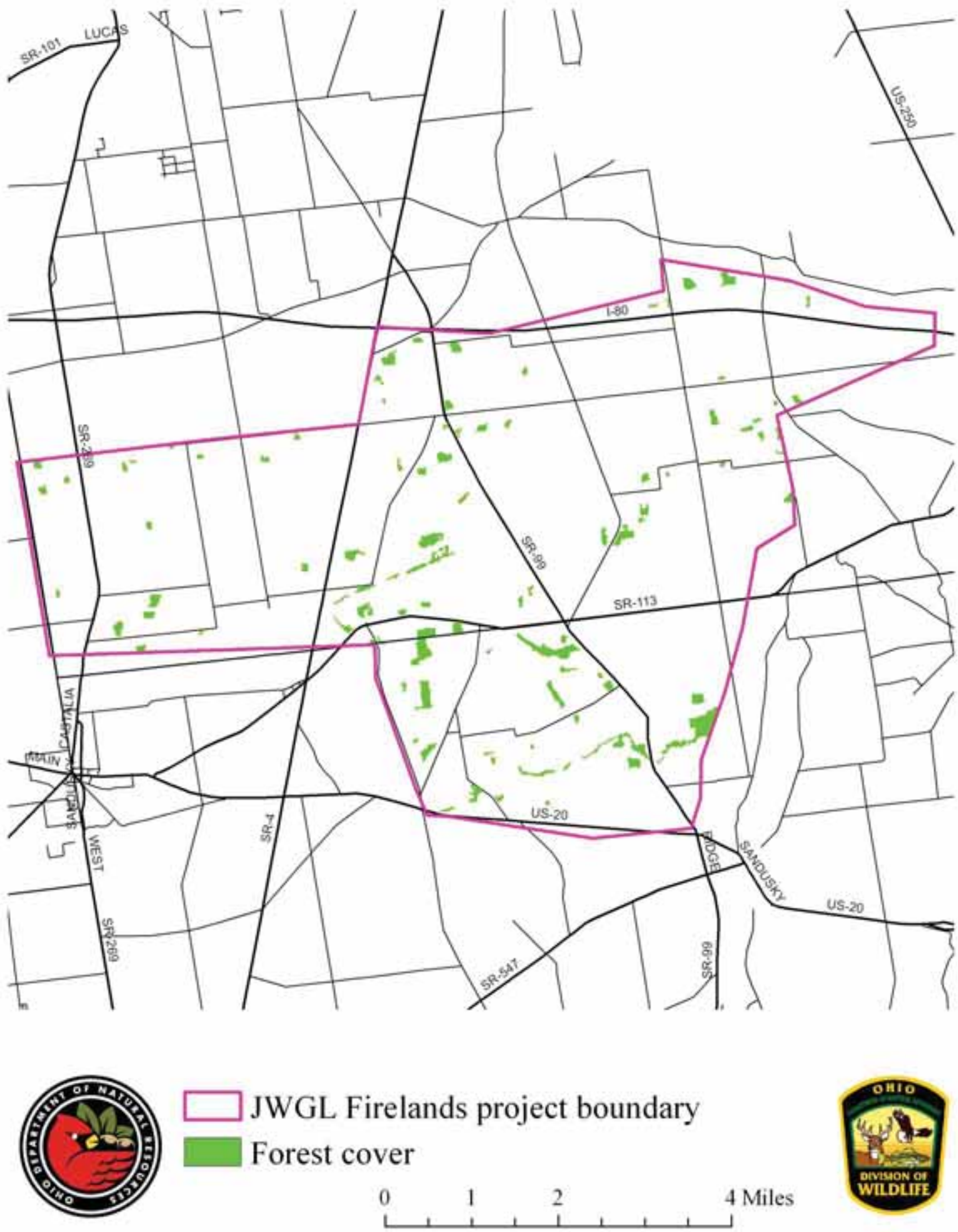
cc: Mr. Stuart Siegfried, Ohio Power Siting Board
Ms. Megan Seymour, United States Fish and Wildlife Service

Figure 1.



JWGL Firelands project boundary
Minimum
Moderate
Moderate (where applicable)
Extensive
0
1.25
2.5
5 Miles
I-80
SR-269
SR-99
SR-113
SR-4
US-20
SR-547
MAIN
WEST
SR-61
DIVISION OF
WILDLIFE
OHIO

Figure 2.


SR-101
LUCAS
US-250
I-80
SR-269
SR-99
SR-113
CASTALIA
MAIN
SANDUSKY
WEST
SR-4
US-20
RIDGE
SANDUSKY
US-20
SR-269
SR-547
SR-99
JWGL Firelands project boundary
Forest cover
0
1
2
4 Miles

Ohio Department of Natural Resources

JOHN R. KASICH, GOVERNOR DAVID MUSTINE, DIRECTOR

Ohio Division of Wildlife

Vicki J. Mountz, Acting Chief
2045 Morse Rd., Bldg. G
Columbus, OH 43229-6693
Phone: (614) 265-6300

April 16, 2011

To all interested parties,

Based upon the project boundary map received on April 7, 2011 the Ohio Department of Natural Resources Division of Wildlife (DOW) has prepared these survey recommendations for juwi Wind's proposed Lyme project located in Sandusky, Huron, and Seneca counties.

Currently the project falls within regions of the state that DOW has identified as needing moderate monitoring efforts. Recommendations are based on a GIS analysis of the site and may be reevaluated after a site visit. Additionally, if the developer decides to amend the current boundaries, the DOW will revise our survey recommendations.

The table below was created based upon a review of the project maps provided and summarizes the types and level of effort recommended by the DOW. Please note that these survey recommendations are in addition to those recommended for juwi Wind's adjacent Fireland's project provided on September 30, 2010.

Results from these studies will help the Department of Natural Resources assess the potential impact these turbines may pose, and influence our recommendations to the Ohio Power Siting Board. Monitoring should follow those criteria listed within the "On-shore Bird and Bat Pre-Construction Monitoring Protocol for Commercial Wind Energy Facilities in Ohio."

For additional ODNR comments, including information on the potential presence of threatened and endangered species within or adjacent to your project area, please contact Brian Mitch at (614) 265-6378 or brian.mitch@dnr.state.oh.us

	Project
Survey type	
Breeding bird	Breeding bird surveys should be conducted at all sites. The number of survey points may be based on the amount of available habitat, or twice the maximum number of turbines proposed for the site. Because agricultural land is not considered to be suitable nesting habitat for most species of bird, turbines placed within these types of habitat are exempt of this recommendation.
Raptor nest searches	Nest searches should occur on, and within a 1-mile buffer of the proposed facility.

Raptor nest monitoring	There is 1 eagle nest located on or within the 2 miles of the proposed project. The pair within the 2 mile radius should be monitored to assess their daily movement patterns. Should any additional nests of a protected species of raptor be located during nest searches, monitoring should commence as outlined within the on-shore protocols.
Bat acoustic monitoring	To be conducted at all meteorological towers.
Passerine migration (# of survey points)	Waived
Diurnal bird/raptor migration (# of survey point)	1
Sandhill crane migration (same points as raptor migration)	NS
Owl playback survey points	NS
Barn owl surveys	NS
Bat mist-netting (# of survey points)	6
Nocturnal marsh bird survey points	NS
Waterfowl survey points	NS
Shorebird migration points	NS
Radar monitoring locations	NS

NS = Not required based on the lack of suitable habitat.

If you have any questions, please feel free to contact me.

Jennifer Norris, Wind Energy Wildlife Biologist
Olentangy Wildlife Research Station
Ohio Division of Wildlife
8589 Horseshoe Road
Ashley, OH 43003
Office phone: 740-747-2525 x 26
Cell: 419-602-3141
Fax: 740-747-2278

cc: Mr. Stuart Siegfried, Ohio Power Siting Board
Ms. Megan Seymour, United States Fish and Wildlife Service
Mr. Brian Mitch, Ohio Department of Natural Resources

Figure 1. Survey effort map with the boundary for juwi Wind's proposed Lyme project.

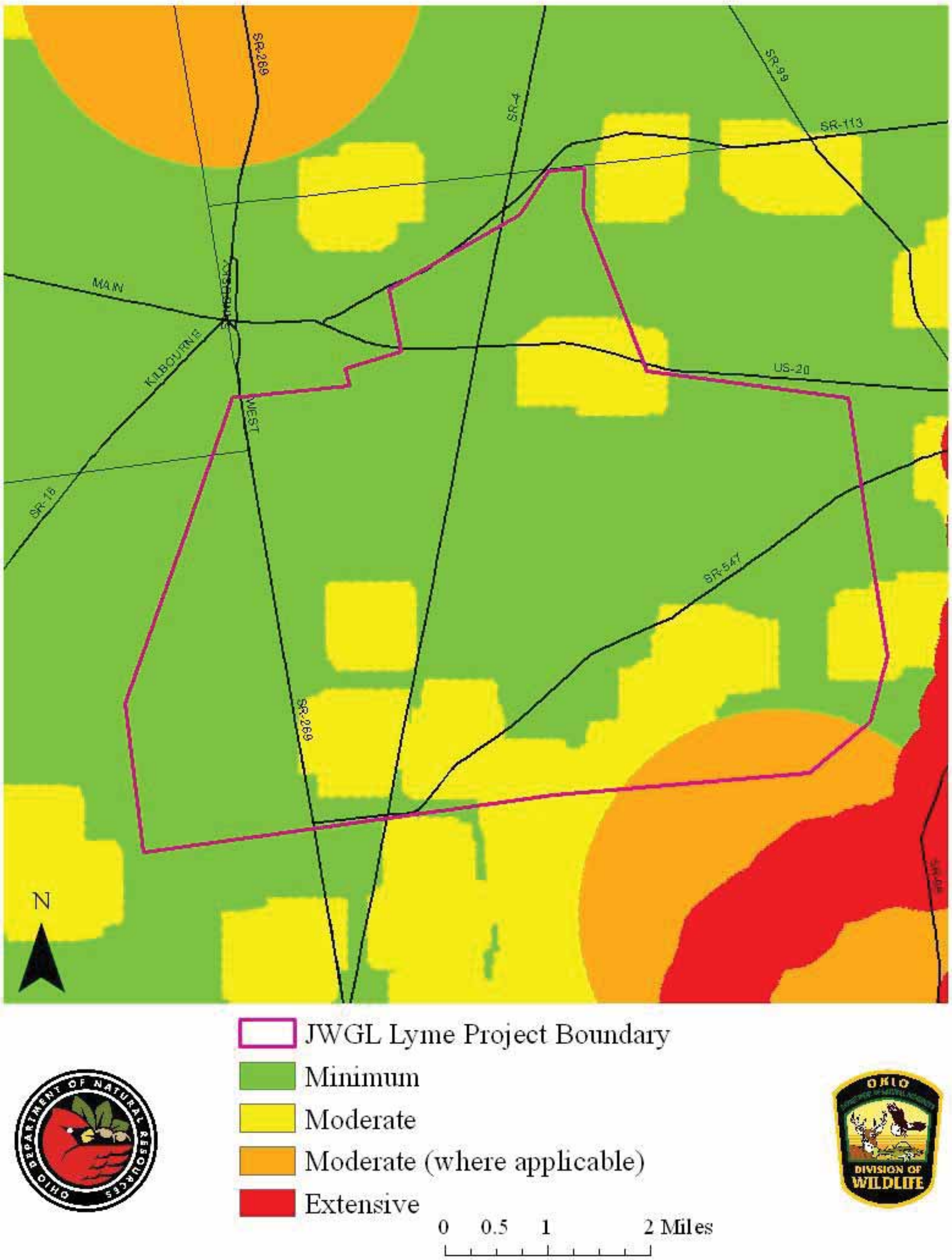
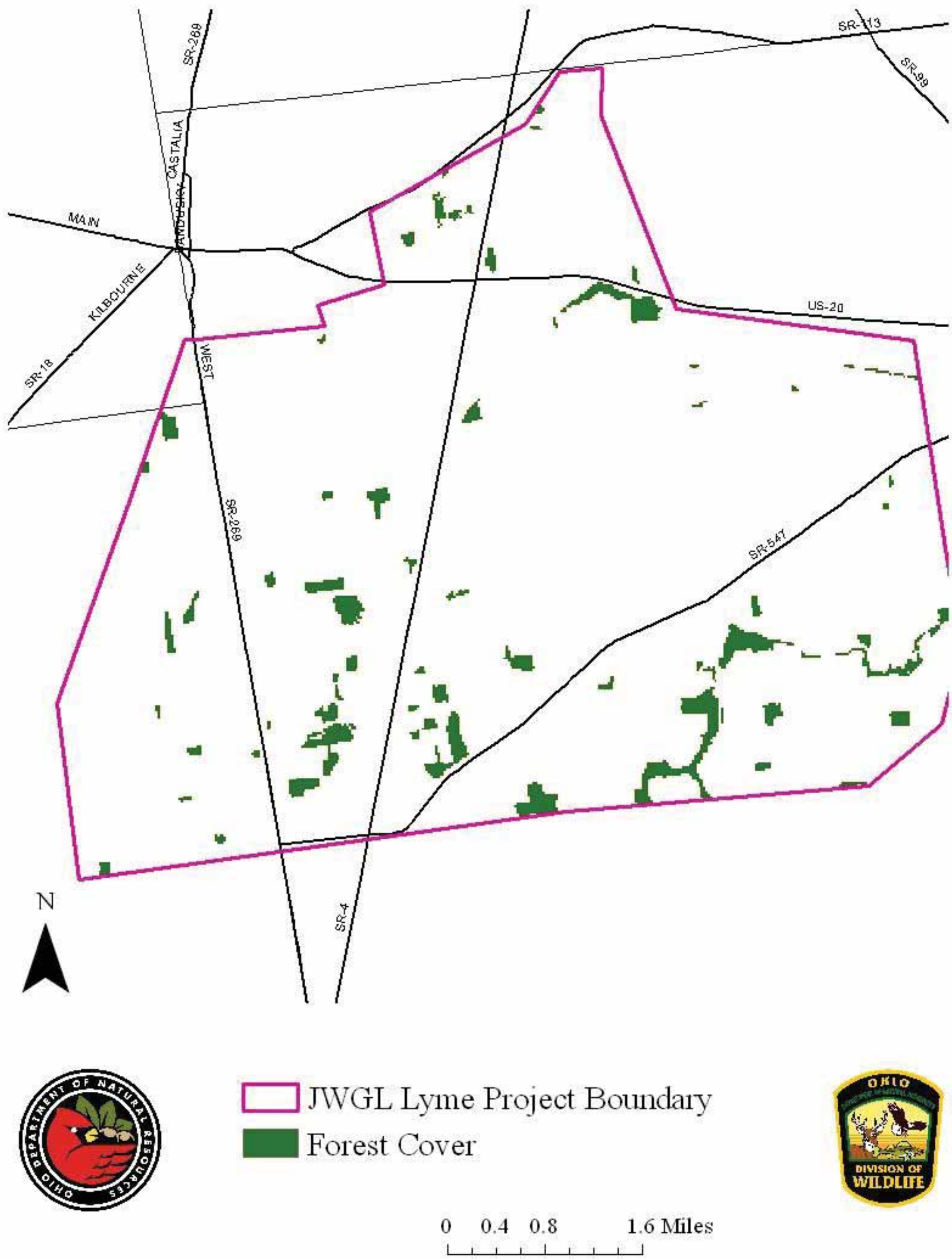


Figure 2. Forest cover with the boundary for juwi Wind's proposed Lyme project.



United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
4625 Morse Road, Suite 104
Columbus, Ohio 43230
(614) 416-8993 / FAX (614) 416-8994

COPY FOR YOUR INFORMATION

April 27, 2011

TAILS : 31420-2011-TA- 0625

Matt Krivos
JUWI Wind, LLC
629 Euclid Ave, Suite 635
Cleveland, OH 44114

Re: Firelands and Phase 2 Lyme Wind Power Projects in Erie, Sandusky, Huron and Seneca Counties

Dear Mr. Krivos:

This letter is in response to the revised Firelands and newly proposed Phase 2 Lyme wind power project in Erie, Sandusky, Huron and Seneca Counties, Ohio. The project areas appear to be a mix of agricultural land with scattered forested areas throughout. The project areas are within ½ mile- 1 mile west of the Huron River. The Firelands project northeast boundary abuts the Lake Erie Western Important Bird Area (IBA). The Firelands project is located approximately 1.5 miles west of the Milan State Wildlife Area. We understand the Firelands and Phase 2 Lyme project is proposed for approximately 100 MW each, including between 100-120 turbines. According to a letter from the Ohio Department of Natural Resources (ODNR) dated September 30, 2010, the Division of Wildlife (DOW) has determined that the Firelands project would be classified as a "moderate" site under the current monitoring protocols based upon the location and land-use practices. In addition, a letter from the ODNR dated April 16, 2011; the DOW has determined the Lyme project would also be classified as "moderate" site.

The following comments are being provided pursuant to the Endangered Species Act (ESA), Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, and Fish and Wildlife Act of 1956. This information is being provided to assist you in making an informed decision regarding wildlife issues, site selection, project design, and compliance with applicable laws. The Service has been working closely with ODNR DOW to develop recommended survey protocols and site evaluations that will satisfy both state and federal wildlife statutes, and this letter describes these measures, in part. The protocols, "On-Shore Bird and Bat Pre- and Post-Construction Monitoring Protocol for Commercial Wind Energy Facilities in Ohio" are available on ODNR's website at:
http://www.dnr.state.oh.us/Home/wild_resourcessubhomepage/ResearchandSurveys/WildlifeWind/tabid/21467/Default.aspx
We encourage and appreciate your early coordination with both ourselves and ODNR, and recommend continued collaboration on this project to ensure wildlife issues are fully and appropriately addressed.

The Service supports the development of wind power as an alternative energy source, however, wind farms can have negative impacts on wildlife and their habitats if not sited and designed with potential wildlife and habitat impacts in mind. Selection of the best sites for turbine placement is enhanced by ruling out sites with known, high concentrations of birds and/or bats passing within the rotor-swept area of the turbines or where the effects of habitat fragmentation will be detrimental. In support of wind power generation as a wildlife-friendly, renewable source of power, development sites with comparatively low bird, bat and other wildlife values, would be preferable and would have relatively lower impacts on wildlife.

WATER RESOURCE COMMENTS:

The Service recommends that impacts to streams and wetlands be avoided, and buffers surrounding these systems be preserved. Streams and wetlands provide valuable habitat for fish and wildlife resources, and the filtering capacity of wetlands helps to improve water quality. Naturally vegetated buffers surrounding these systems are also important in preserving their wildlife-habitat and water quality-enhancement properties. Furthermore, forested riparian systems (wooded areas adjacent to streams) provide important stopover habitat for birds migrating through the region. The proposed activities do not constitute a water-dependent activity, as described in the Section 404(b)(1) guidelines, 40 CFR 230.10. Therefore, practicable alternatives that do not impact aquatic sites are presumed to be available, unless clearly demonstrated otherwise. Therefore, before applying for a Section 404 permit, the client should closely evaluate all project alternatives that do not affect streams or wetlands, and if possible, select an alternative that avoids impacts to the aquatic resource. If water resources will be impacted, the Buffalo District of the U.S. Army Corps of Engineers should be contacted for possible need of a Section 404 permit.

ENDANGERED SPECIES COMMENTS:

Because of the potential for wind power projects to impact endangered bird, bat, or other listed species, they are subject to the Endangered Species Act (16 U.S.C. 1531-1544) section 9 provisions governing "take", similar to any other development project. Take incidental to a lawful activity may be authorized through the initiation of formal consultation if a Federal agency is involved; or if a Federal agency, Federal funding, or a Federal permit are not involved in the project, an incidental take permit pursuant to section 10(a)(1)(B) of the ESA may be obtained upon completion of a satisfactory habitat conservation plan for the listed species. However, there is no mechanism for authorizing incidental take "after-the-fact."

The proposed project lies within the range of the **Indiana bat** (*Myotis sodalis*), a federally listed endangered species. Since first listed as endangered in 1967, their population has declined by nearly 60%. Several factors have contributed to the decline of the Indiana bat, including the loss and degradation of suitable hibernacula, human disturbance during hibernation, pesticides, and the loss and degradation of forested habitat, particularly stands of large, mature trees. Fragmentation of forest habitat may also contribute to declines. During the winter Indiana bats hibernate in caves and abandoned mines. Summer habitat requirements for the species are not well defined but the following are considered important:

1. Dead or live trees and snags with peeling or exfoliating bark, split tree trunk and/or branches, or cavities, which may be used as maternity roost areas.

2. Live trees (such as shagbark hickory and oaks) which have exfoliating bark.

3. Stream corridors, riparian areas, and upland woodlots which provide forage sites.

Indiana Bat Maternity Habitat

There are no positive records for Indiana bat captures within Erie, Sandusky, Huron and Seneca Counties and in addition, there are no records within 10 miles of the proposed project boundaries. This may reflect more a function of low survey effort rather than the relative abundance of the species. The project areas appear to be a mix of agricultural land with scattered forested areas throughout, with a number of forested areas exceeding 50-100 acres. It appears that suitable summer foraging and roosting habitat for the Indiana bat likely exists within the project area.

Mist Net Surveys: Based on ODNR's On-Shore Bird and Bat Pre- and Post-Construction Monitoring Protocol for Commercial Wind Energy Facilities in Ohio, a total of 5 mist net surveys have been requested for the Firelands project and 6 mist net surveys for the Lyme project. The Service agrees that this is an appropriate level of effort for the proposed project boundaries. The surveys must be conducted by a permitted surveyor (see attached list) and be designed and conducted in coordination with the Endangered Species Coordinator for this office. Survey effort should follow ODNR's protocols, which exceed the Service's standard protocol. The highest quality Indiana bat habitat areas within the project area should be selected for mist netting. We recommend that any Indiana bats captured, especially reproductively active females, be monitored through radio-tracking to determine roost locations and foraging patterns. If an Indiana bat is captured, this office shall be notified within 24 hours, or by the next business day.

Radio Transmitters: Up to four Indiana bats should be fitted with radio transmitters and tracked to roost site(s) and foraging areas until daily activity patterns are fairly well established, or as long as the transmitter remains attached and activated. Preference shall be given to tracking female bats, though one male Indiana bat may be tracked if captured prior to capturing four female Indiana bats. Please see the ODNR's protocols for additional information on radio tracking non-Indiana bats.

Acoustic Surveys: Bat acoustic monitoring is to be conducted at all meteorological towers within the project areas, with 1 unit positioned at 5 meters off the ground and 1 unit within the rotor swept area. Met towers should be erected within both phases of the project to ensure adequate coverage of the project areas. We recommend regular inspection of the AnaBat detectors throughout the survey period to ensure proper functioning.

The results of all bat surveys should be coordinated with this office prior to initiation of any work. Based on the results of the mist net survey, we will evaluate potential impacts to the Indiana bat from the proposed project. If sufficient information is not provided to document that take is unlikely, authorization of incidental take either through Section 7 or Section 10 of the Endangered Species Act of 1973, as amended, will be necessary.

<u>Hibernacula Habitat</u>
The project area lies within an area primarily underlain with Silurian and Devonian carbonate bedrock, indicating that the presence of caves is possible, and several identified karst areas are found within the project area. Please see the Ohio Department of Natural Resources, Division of Geological Survey Ohio Karst Areas Map (www.dnr.state.oh.us/portals/10/pdf/karstmap.pdf,), for additional information. If caves or sinkholes are present within the project area, we recommend further coordination with this office to determine if surveys of these areas are recommended.

<u>Indiana Bat Migratory Habitat</u>
Wind energy facilities in various habitat types across the U.S. and Canada have been documented to cause "widespread and often extensive fatalities of bats" (Arnett *et al.* 2008), primarily during the fall *migratory* season. Further, Indiana bat mortality has been detected at a wind power facility in Indiana, confirming suspicions that fall migrating Indiana bats are also susceptible to mortality from wind turbines. At this time, research into the mechanisms that cause mortality of bats at wind power sites is still ongoing, and few operational tools exist to avoid and minimize take — feathering of turbines during times when bats are most at risk has been shown to reduce mortality in some situations. Based on this, we are advising all operating wind farms and wind farms in planning stages within the range of the listed bats that lethal take is a possibility without curtailment of operations at night during the migratory period regardless of

whether summer habitat is present or if Indiana bats are detected during summer mist netting. Due to the potential of take during spring and fall migration, we recommend developers evaluate their exposure to the prohibitions of ESA. This is a risk management decision the developer must make. The Service advises you to consider the following two options to ensure violations of the Endangered Species Act (ESA) Section 9 take prohibition do not occur:

1) Feather turbines during low wind speed conditions at night during the fall and spring migratory seasons as a way to proactively and definitively avoid take of Indiana bats (and other species of bats as well). Based on the Indiana bat Draft Recovery Plan First Revision (Service, 2007), fall migration generally occurs between August 1 and October 15, and spring migration generally occurs between April 1 and May 15.

2) Wind facility developers can work with the Service to apply for an Incidental Take Permit by submitting a Habitat Conservation Plan (HCP), as required under Section 10 of the Endangered Species Act. A HCP can be used to address Indiana bat presence during both summer foraging and migration periods. A HCP does typically require some time and survey effort to complete. Alternatively, you may consider joining in the regional effort to develop a wind power HCP to address Indiana bats and other listed species.

If you plan to implement either of these two options, please contact us for further information.

The proposed project lies within the range of the federally listed endangered **piping plover** (*Charadrius melodus*), as well as the federally threatened **eastern prairie fringed orchid** (*Platanthera leucophaea*), **Lakeside daisy** (*Hymenoxys herbacea*), and **Lake Erie Watersnake** (*Nerodia sipedon insularum*). Due to the location of the proposed project areas, impacts are not anticipated for these species.

The proposed project lies within the range of the **Kirtland's warbler** (*Dendroica kirtlandii*), a federally listed endangered species. The Kirtland's warbler is a small blue-gray songbird with a bright yellow breast. This species migrates through Ohio in the spring and fall, traveling between its breeding grounds in Michigan, Wisconsin, and Ontario and its wintering grounds in the Bahamas. During migration, individual birds usually forage in low vegetation and stay in one area for a few days. This species prefers shrub habitat and the Service recommends a habitat assessment for these project areas to see if surveys are warranted. If habitat is present with the project boundary, pre-construction survey methods should be coordinated with the Service and ODNR and surveys should be conducted in the spring season from April 15- June 1 and fall season from August 1- October 15. Any sightings should be reported to the Service within 24 hours, or the next business day. Survey results will be evaluated to document the extent to which the proposed project may affect the Kirtland's warbler.

The project lies within the range of the **eastern massasauga** (*Sistrurus catenatus catenatus*), a docile rattlesnake that is declining throughout its national range and is currently a Federal Candidate species. The snake is currently listed as endangered by the State of Ohio. Your proactive efforts to conserve this species now may help avoid the need to list the species under the Endangered Species Act in the future. Due to their reclusive nature, we encourage early project coordination to avoid potential impacts to massasaugas and their habitat. At a minimum, project evaluations should contain delineations of whether or not massasauga habitat occurs within project boundaries.

The massasauga is often found in or near wet areas, including wetlands, wet prairie, or nearby woodland or shrub edge habitat. This often includes dry goldenrod meadows with a mosaic of early successional woody species such as dogwood or multiflora rose. Wet habitat and nearby dry edges are utilized by the snakes, especially during the spring and fall. Dry upland areas up to 1.5 miles away are utilized during the summer, if available. For additional information on the eastern massasauga, including project management ideas, please visit the following website: http://www.fws.gov/midwest/Endangered/lists/candidat.html or contact this office directly. There is known population north of the project boundary in Margaretta Township, Erie County. This population is less than 1 mile from the project Firelands boundary however, the current status of this population is unknown. The Service suggests conducting a habitat assessment within the project area to determine if appropriate habitat is present. If habitat is present within the project area, surveys may be warranted and will need to be coordinated with this office.

The proposed project lies within the range of the **rayed bean** (*Villosa fabalis*), a freshwater mussel that is currently proposed for listing as federally endangered. The rayed bean is generally known from smaller, headwater creeks, but records exist in larger rivers. They are usually found in or near shoal or riffle areas, and in the shallow, wave-washed areas of lakes. Substrates typically include gravel and sand, and they are often associated with, and buried under the roots of, vegetation, including water willow (*Justicia americana*) and water milfoil (*Myriophyllum* sp.). Should the proposed project directly or indirectly impact any of the habitat types described above, we recommend that a survey be conducted to determine the presence or probable absence of rayed bean mussels in the vicinity of the proposed site. Any survey should be designed and conducted in coordination with the Endangered Species Coordinator for this office.

MIGRATORY BIRD COMMENTS:

The Migratory Bird Treaty Act (16 U.S.C. 703-712; MBTA) implements four treaties that provide for international protection of migratory birds. The MBTA prohibits taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Department of the Interior. While the MBTA has no provision for allowing unauthorized take, the FWS recognizes that some birds may be taken during activities such as wind turbine operation even if all reasonable measures to avoid take are implemented. The U.S. Fish and Wildlife Service's (FWS) Office of Law Enforcement carries out its mission to protect migratory birds not only through investigation and enforcement, but also through fostering relationships with individuals and industries that proactively seeks to eliminate their impacts on migratory birds. Although it is not possible under the MBTA to absolve individuals, companies, or agencies from liability (even if they implement avian mortality avoidance or similar conservation measures), the Office of Law Enforcement focuses on those individuals, companies, or agencies that take migratory birds with disregard for their actions and the law, especially when conservation measures have been developed but are not properly implemented.

At this time, we continue to encourage existing and proposed wind developments to follow current Service recommendations on wind power siting and construction (*Interim Guidelines to Avoid and Minimize Impacts from Wind Turbines – 2003)*. The Service also encourages developers to coordinate with Service biologists regarding their projects. Proper coordination will help developers make informed decisions in siting, constructing, and operating their facilities. Additionally, the Service hopes to work cooperatively with wind developers to advance the state of the art of wind power siting, construction, and operation. Advancements in these areas will represent great strides towards the environmentally safe development of this otherwise renewable and clean source of energy.

The Service and ODNR have worked together to develop a recommended bird survey protocol for wind turbine projects. The details of the protocol are provided in ODNR's On-Shore Bird and Bat Pre- and Post-Construction Monitoring Protocol for Commercial Wind Energy Facilities in Ohio. ODNR has documented that the project area qualifies for "moderate" survey effort due to the proximity to possible migratory bird high use areas. We recommend implementation of the ODNR bird survey protocol to document baseline bird use of the project area. Bird survey results will be interpreted to determine if potential risk to birds is relatively high or low in various portions of the project area. Based on survey results we may make recommendations as to turbine placement and operation, or pre- or post-construction monitoring.

Research into the actual causes of bat and bird collisions with wind turbines is limited. To assist Service field staffs in review of wind farm proposals, as well as aid wind energy companies in developing best practices for siting and monitoring of wind farms, the Service published *Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines* (2003). On February 8, 2011, the U.S. Fish and Wildlife Service released the Draft Voluntary, Land-Based Wind Energy Guidelines that have now been published in the Federal Register and are now open for public comment until May 19, 2011. The Guidelines can be found at: http://www.fws.gov/windenergy. Until those guidelines are final, the Service recommends following the 2003 Interim Guidelines. We encourage any company/licensee proposing a new wind farm to consider the following excerpted suggestions from the guidelines in an effort to minimize impacts to migratory birds and bats.

1) Pre-development evaluations of potential wind farm sites to be conducted by a team of Federal and/or State agency wildlife professions with no vested interest in potential sites;

2) Rank potential sites by risk to wildlife;

3) Avoid placing turbines in documented locations of federally-listed species;

4) Avoid locating turbines in known bird flyways or migration pathways, or near areas of high bird concentrations. (i.e., rookeries, leks, State or Federal refuges, staging areas, wetlands, riparian corridors, etc.) Avoid known daily movement flyways and areas with a high incidence of fog, mist or low visibility;

5) Avoid placing turbines near known bat hibernation, breeding, or maternity colonies, in migration corridors, or in flight paths between colonies and feeding areas;

6) Configure turbine arrays to avoid potential avian mortality where feasible. (i.e., group turbines and orient rows of turbines parallel to known bird movements) Implement storm water management practices that do not create attractions for birds, and maintain contiguous habitat for area-sensitive species;

7) Avoid fragmenting large, contiguous tracts of wildlife habitat. Wherever practical, place turbines on lands already disturbed and away from intact healthy native habitats. If not practical, select fragmented or degraded habitats over relatively intact areas;

8) Minimize roads, fences, and other infrastructure. Wherever possible, align collection lines and access roads to minimize disturbance;

9) Develop a habitat restoration plan for the proposed site that avoids or minimizes negative impacts on vulnerable wildlife while maintaining or enhancing habitat values for other species. (i.e., avoid attracting prey animals used by raptors;

10) Use tubular supports with pointed tops rather than lattice supports to minimize bird perching and nesting opportunities. Avoid placing external ladders and platforms on tubular towers to minimize perching/nesting. Avoid use of guy wires for turbine or meteorological tower supports. All existing guy wires should be marked with bird deterrents. (Avian Power Line Interaction Committee 1996);

11) If taller turbines (top of rotor-swept area is greater than 199 feet above ground level) require lights for aviation safety, the minimum amount of lighting specified by the Federal Aviation Administration (FAA) should be used. Unless otherwise requested by the FAA, only white strobe lights should be used at night, and should be of the minimum intensity and frequency of flashes allowable;

12) Adjust tower height to reduce risk of strikes in areas of high risk for wildlife.

13) Wherever feasible, place electric power lines underground or on the surface as insulated, shielded wire to avoid electrocution of birds. Use recommendations of the Avian Power Line Interaction Committee (1996) for any required above-ground lines, transformers, or conductors;

The full text of the guidelines is available at http://www.fws.gov/habitatconservation/wind.pdf. The Service believes that implementing these guidelines may help reduce mortality caused by wind turbines. We encourage you to consider these guidelines in the planning and design of the project. We particularly encourage placement of turbines away from any large wetland, stream corridor, or wooded areas, including the areas mentioned previously, and avoid placing turbines between nearby habitat blocks.

BALD AND GOLDEN EAGLE COMMENTS:

Bald and golden eagles are included under the Migratory Bird Treaty Act, but are afforded additional legal protection under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d). The Service recently issued a final rule that authorizes issuance of eagle take permits, where the take to be authorized is associated with otherwise lawful activities. If take of bald eagles is likely, based on the best information available, a bald eagle take permit for this project will be necessary. There is a known bald eagle nest located within the northwest corner of the Firelands project boundary. We understand that some monitoring of this nest was conducted in 2010. In addition, the proposed Lyme Phase 2 project boundary has a bald eagle nest located approximately 1.3 miles south of the project boundary on the eastern side of the project. There are also 3 other bald eagle nests located north (2.2 miles) and east (2.4 and 2.5 miles) of the Firelands project boundary. Raptor nest searches and nest monitoring should be conducted in accordance with ODNR's survey protocol to identify any raptors, including bald eagles that may nest or migrate within or near the project area. The results of this survey should be coordinated with this office.

On February 8, 2011, the U.S. Fish and Wildlife Service released the Draft Eagle Conservation Plan Guidance that have now been published in the Federal Register and are available for public comment until May 19, 2011. The Guidelines can be found at: http://www.fws.gov/windenergy. The Draft Eagle Conservation Plan Guidance was developed to provide interpretive guidance to wind developers, Service biologists who evaluate potential impacts on eagles from proposed wind energy projects, and others in applying the regulatory permit standards as specified by the Bald and Golden Eagle Protection Act and other federal laws. Appendix C of the Draft Eagle Conservation Plan Guidance suggests a monitoring protocol for wind projects that is more extensive that ODNR's current protocol. This guidance suggests a way to estimate relative abundance and eagle exposure rates, characterization of the project area nesting population, and eagle migration and concentration areas. While this guidance is still draft, we believe that it deserves careful attention, as it lays out a proposed process for evaluating risk to eagles from wind power projects and developing an eagle conservation plan, in support of applying for a permit to authorize take. Monitoring data should be interpreted to document potential risk to eagles. If take of eagles is likely, a bald eagle take permit will be necessary.

COORDINATION OF SURVEY RESULTS:

Please submit survey results to this office for review. Survey results will be interpreted to determine areas with relatively low bat and bird activity/diversity as opposed to areas with relatively high bat and bird activity/diversity. Based on the survey results, we may make recommendations as to turbine placement and operation, additional consultation under Section 7 or 10 of the Endangered Species Act of 1973, as amended, additional permits under the Bald and Golden Eagle Protection Act, or pre- or post-construction monitoring.

POST CONSTRUCTION MONITORING:

The Service recommends the project be monitored post-construction to determine impacts to migratory birds and bats. A specific post-construction monitoring plan should be prepared and reviewed by the Service and should include a scientifically robust, peer reviewed methodology of mortality surveys. We recommend that the post-construction monitoring protocol be developed based on the results of pre-construction monitoring, and look forward to working with the project proponent to develop this document.

Thank you for the opportunity to provide comments on this proposed project. Please contact biologist Melanie Cota at extension 15 in this office if I can be of further assistance.

Sincerely,

Jerome M. Gojgb

for Mary Knapp, Ph.D.
Supervisor

Cc: Ms. Jennifer Norris, ODNR, Olentangy Wildlife Research Station, Ashley, OH
Mr. Brian Mitch, ODNR, REALM, Columbus, OH
Mr. Doug McIlvain, Tetra Tech, 250 W Court St. 200W, Cincinnati, OH 45202

Attachment: USFWS Permitted Indiana bat Surveyors in Ohio

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
4625 Morse Road, Suite 104
Columbus, Ohio 43230
(614) 416-8993 / FAX (614) 416-8994
March 22, 2011

USFWS permittees for Indiana bat surveys in Ohio*

ABR, Inc. – Environmental Research and Services Leslie Rodman P.O. Box 249 Forest Grove, OR 97116 (503) 359-7525 ext. 113 / FAX (503) 359-8875 lrodman@abrinc.com	**Alliance Consulting Inc.** T. Sydney Burke 124 Philpott Lane Beaver, WV 25813 (304) 255-0491 ext. 343 / FAX (304) 255-4232 sburke@aci-wv.com
Apogee Environmental Consultants, Inc. Joel Beverly P.O. Box 338 Ermine, KY 41815 (606) 633-7677 / FAX (606) 632-2626 apogee_env@bellsouth.net	**Appalachian Technical Services** P.O. Box 3537 6741 Indian Creek Road Wise, VA 24293 (276) 328-4200 / FAX (276) 328-4900 wise@atsone.com
BHE Environmental 11733 Chesterdale Road Cincinnati, OH 45246 (513) 326-1500 / FAX (513) 326-1550 ktyrell@bheenvironmental.com	**Eric Britzke** 112 Cherokee Trail Clinton, MS 39056 (870) 261-3666 Eric.R.Britzke@usace.army.mil
Timothy Carter Ball State University Department of Biology, CL 121 Muncie, IN 47306-0440 (765) 285-8842 / FAX (765) 285-8804 tccarter@bsu.edu **Copperhead Environmental Consulting, Inc.** P.O. Box 73 11641 Richmond Road Paint Lick, KY 40461 (859) 925-9012 mwgumbert@copperheadconsulting.com	**Civil & Environmental Consultants** Katie Dunlap 8740 Orion Place, Suite 100 Columbus, OH 43240 (614) 710-0175 / (888) 598-6808 FAX (614) 540-6638 kdunlap@cecinc.com 3600 Park 42 Drive, Suite 130B Cincinnati, OH 45241-2072 (513) 985-0226 / (800) 759-5614 333 Baldwin Road Pittsburgh, PA 15205-9702 (412) 429-2324 / (800) 365-2324 FAX (412) 429-2114

Davey Resource Group Jessica Hickey 1500 N. Mantua St., P.O. Box 5193 Kent, OH 44240-5193 (800) 828-8312 / FAX (330) 673-0860 jessica.hickey@davey.com	**Ecological Specialties** LLC William D. Hendricks 1785 Symsonia Road Symsonia, KY 42082 (270) 851-4362 / FAX (270) 851-4363 myotis@hughes.net
Ecology and Environment, Inc. Josh Flinn 55 Corporate Woods 9300 West 110th St., Suite 645 Overland Park, KS 66210 (913) 339-9519 / FAX (913) 458-0972 jflinn@ene.com	**Eco-Tech, Inc.** Peter Lee Droppelman 1003 E. Main St. Frankfort, KY 40601 (502) 695-8060 / FAX (510) 695-8061 ldroppelman@ecotechinc.com
Environmental Solutions & Innovations Virgil Brack, Jr. 781 Neeb Road Cincinnati, OH 45233 (513) 451-1777 / FAX (513) 451-3321 vbrack@evironmentalsi.com	**Jackson Environmental Consulting** Jeremy Jackson 203 North Mayo Trail Pikeville, KY 41501 (606) 432-9345 / FAX (606) 437-6563 jlj@jacksonenvironmental.com
J.F. New & Associates, Inc. Jeremy Sheets 708 Roosevelt Road Walkerton, IN 46574 (574) 586-3400/ FAX (574) 586-3446 jsheets@jfnew.com	**Daniel Judy** LPG Environmental and Permitting Services 1174 Camp Avenue Mount Dora, FL 32757 (352) 383-1444 djudy@lpgenvironmental.com
Robert Kiser 38 Kiser Lane Whitesburg, KY 41858	**Andrew Kniowski** 2021 Coffey Road 210 Kottman Hall Columbus, OH 43210 (540) 420-5213 kniowski.1@osu.edu
Allen Kurta Eastern Michigan University Department of Biology 316 Mark Jefferson Ypsilanti, MI 48197 (734) 487-4242 / FAX (734) 487-9235 akurta@emich.edu	**Michelle Malcosky** 266 Atterbury Blvd. Hudson, OH 44236 (330) 968-8272 mmalcosky@gmail.com

Rodney McClanahan 265 Moss Lane Anna, IL 62906 (618) 658-1317 turkeyctr@earthlink.net	**Mountain State Biosurveys, LLC** Thomas Risch 6703 Ohio River Road Lesage, WV 25537 (304) 762-2453 www.mtnstatebio.com
Marlo Perdicas 9186 Baer Road Marshallville, OH 44645	**Pittsburgh Wildlife & Environmental, Inc.** Neil Bossart 853 Beagle Club Road McDonald, PA 15057 (724) 796-5137 nbossart@windstream.net
Redwing Ecological Services, Inc. Benjamin Deetsch 129 South Sixth Street Louisville, KY 40202 (502) 625-3009 FAX (502) 625-3077 kfuchs@rewing.win.net **Lynn Robbins** Southwest Missouri State University Department of Biology 901 South National Avenue Springfield, MO 65804-0095 (417) 836-5366 FAX (417) 836-4204 lwr704f@smsu.edu	**Stantec Consulting Services, Inc.** Jeff Brown 11687 Lebanon Road Cincinnati, OH 45241 (513) 842-8205 / FAX (513) 842-8250 jeff.brown@stantec.com Bob Madej 1500 Lakeshore Drive, Suite 100 Columbus, OH 43204 (614) 486-4383 / FAX (614) 486-4387 robert.madej@stantec.com James Kiser 1901 Nelson Miller Parkway Louisville, KY 40223 (502) 212-5000 / FAX (502) 212-5055 james.kiser@stantec.com
Merrill Tawse 791 Woodland Road Mansfield, OH 44906 (419) 756-1203 / cell (419) 989-2335 mtawsebats@yahoo.com	**Third Rock Consultants, LLC** Rain Storm 2514 Regency Rd., Suite 104 Lexington, KY 40503 (859) 977-2000 / FAX (859) 977-2001 mforee@thirdrockconsultants.com
John Timpone 427 Terrington Drive Ballwin, MO 63021 (417) 894-5554 wanderingwolverine13@yahoo.com	**Tragus Environmental Consulting** Mike Johnson Endangered Species Consultants 37 North Highland Avenue Akron, OH 44303 (330) 472-7013 mike@tragusinc.com

Brianne Lorraine Walters Dept. of Ecology and Organisimal Biology Indiana State University Terre Haute, IN 47809 (812) 237-8294 / FAX (812) 237-2526 bwalters2@isugw.indstate.edu	**Western Ecosystems Technology, Inc.** Stephen Brandebura 2003 Central Avenue Cheyenne, WY 82001 (307) 634-1756 / FAX (307) 637-6981 sbrandebura@west-inc.com
John O. Whitaker, Jr. Department of Life Sciences Indiana State University Terre Haute, IN 47809 (812) 237-2383 / FAX (812) 237-2526 jwhitaker3@isugw.indstate.edu	

*This list reflects permit data available as of March 22, 2011, and is subject to periodic revision to reflect permit changes

Ohio Department of Natural Resources
JOHN R. KASICH, GOVERNOR
DAVID MUSTINE, DIRECTOR

Ohio Division of Wildlife
David B. Lane, Chief
2045 Morse Rd., Bldg. G
Columbus, OH 43229-6693
Phone: (614) 265-6300

May 21, 2011

To all interested parties,

Based upon the revised project boundary map received on April 28, 2011 and conference call on April 20, 2011 the Ohio Department of Natural Resources Division of Wildlife (DOW) has prepared these survey recommendations for juwi Wind's proposed combined Firelands-Lyme project located in Erie, Huron, and Seneca counties.

Currently the project falls within regions of the state that DOW has identified as needing moderate monitoring efforts. Recommendations are based on a GIS analysis of the site and may be reevaluated after a site visit. Additionally, if the developer decides to amend the current boundaries, the DOW will revise our survey recommendations.

The table below was created based upon a review of the project maps provided and summarizes the types and level of effort recommended by the DOW. Please note that monitoring and surveys should follow those criteria listed within the "On-shore Bird and Bat Pre-Construction Monitoring Protocol for Commercial Wind Energy Facilities in Ohio." Tetra Tech's proposed bald eagle nest monitoring methodology following the U.S. Fish and Wildlife Service's draft ECPG is approved for this site, however all other surveys should adhere to ODNR protocol.

Results from these studies will help the Department of Natural Resources assess the potential impact these turbines may pose, and influence our recommendations to the Ohio Power Siting Board.

For additional ODNR comments, including information on the potential presence of threatened and endangered species within or adjacent to your project area, please contact Brian Mitch at (614) 265-6378 or brian.mitch@dnr.state.oh.us

	Project
Survey type	
Breeding bird	Breeding bird surveys should be conducted at all sites. The number of survey points may be based on the amount of available habitat, or twice the maximum number of turbines proposed for the site. If turbines are placed in agricultural land it, this requirement may be waived by DOW after a review of the proposed turbine locations is provided.
Raptor nest searches	Nest searches should occur on, and within a 1-mile buffer of the proposed facility.

Raptor nest monitoring	There are 2 eagle nest located on or within the 2 miles of the proposed project. The pairs within the 2 mile radius should be monitored to assess their daily movement patterns. Should any additional nests of a protected species of raptor be located during nest searches, monitoring should commence as outlined within the on-shore protocols.
Bat acoustic monitoring	To be conducted at all meteorological towers.
Passerine migration (# of survey points)	4 (waived)
Diurnal bird/raptor migration (# of survey point)	1
Sandhill crane migration (same points as raptor migration)	NS
Owl playback survey points	NS
Barn owl surveys	NS
Bat mist-netting (# of survey points)	9
Nocturnal marsh bird survey points	NS
Waterfowl survey points	NS
Shorebird migration points	NS
Radar monitoring locations	NS

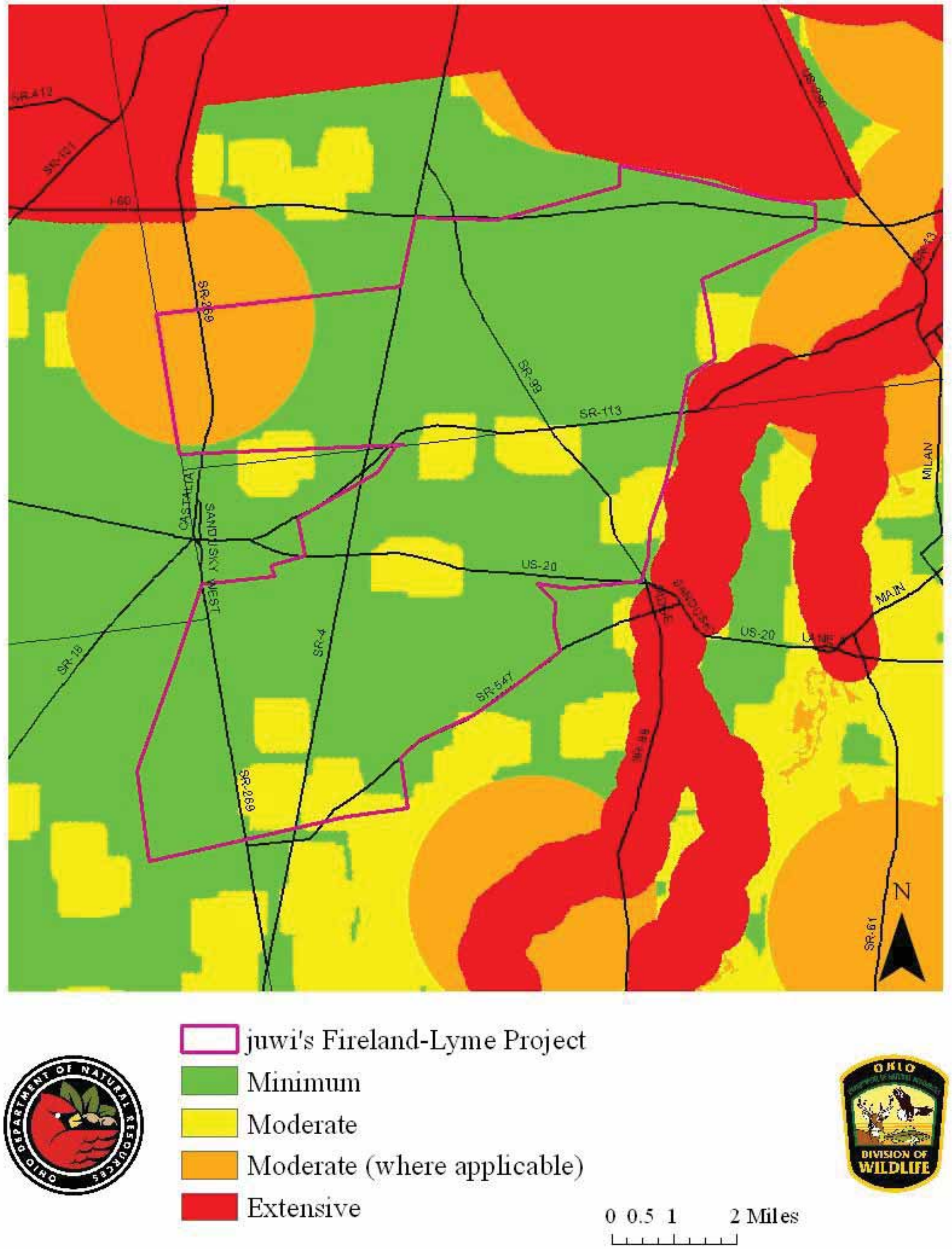
NS = Not required based on the lack of suitable habitat.

If you have any questions, please feel free to contact me.

Jennifer Norris, Wind Energy Wildlife Biologist
Olentangy Wildlife Research Station
Ohio Division of Wildlife
8589 Horseshoe Road
Ashley, OH 43003
Office phone: 740-747-2525 x 26
Cell: 419-602-3141
Fax: 740-747-2278

cc: Mr. Stuart Siegfried, Ohio Power Siting Board
Ms. Megan Seymour, United States Fish and Wildlife Service
Mr. Brian Mitch, Ohio Department of Natural Resources

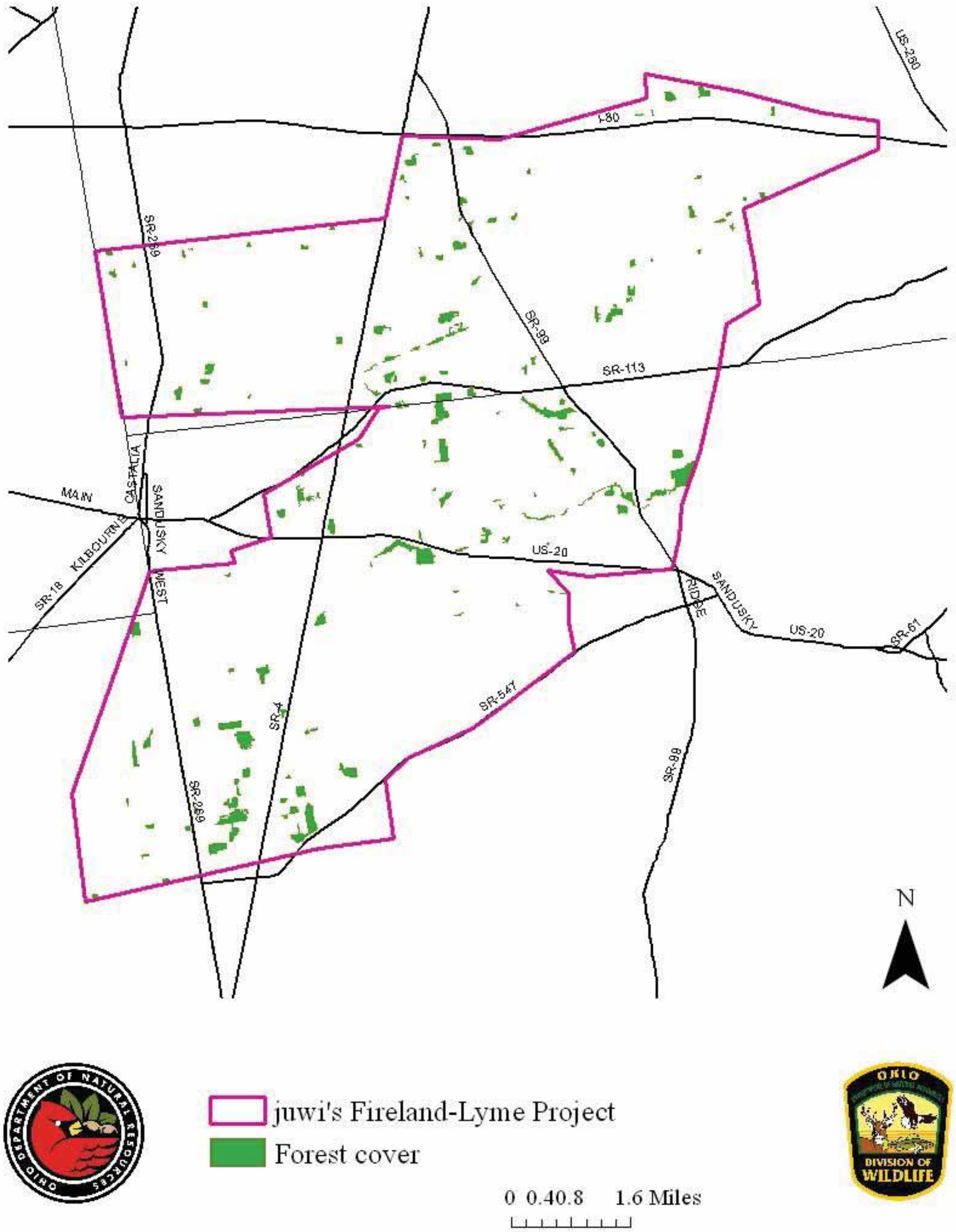
Figure 1. Survey effort map with the boundary for juwi Wind's proposed and revised Firelands-Lyme project.



Ohio Department of Natural Resources

JOHN R. KASICH, GOVERNOR — DAVID MUSTINE, DIRECTOR

Figure 2. Forest cover with the boundary for juwi Wind's proposed and revised Firelands-Lyme project.



TETRA TECH

October 17, 2011

Jennifer Norris
ODNR, Division of Wildlife
8589 Horseshoe Road
Ashley, Ohio 43003
Phone: (740) 747-2525 Ext: 26

Subject: Sandhill Crane Observations
Firelands / Lyme Wind Project
Tetra Tech Project: 103P178401

Ms. Norris,

Tetra Tech EM Inc. (Tetra Tech) was contracted by juwi Wind, LLC (JUWI) to perform preconstruction avian and bat studies for the proposed Firelands & Lyme Wind Energy Project Area (Project Area) located in Erie and Huron Counties, Ohio.

Tetra Tech's methodology for data collection during all avian studies includes the collection of incidental bird observations. These observations, while not the primary focus of our survey effort provide an additional dataset of information. Incidental data are then incorporated into the analysis and characterization of the overall avian community occurring in the Project Area. On two separate occasions during our bi-monthly Bald Eagle Point Count Surveys, Tetra Tech wildlife biologists have observed greater sandhill cranes (*Grus canadensis tabida*) within the Lyme portion of the Project Area. The observations were made on April 26th, 2011 and June 29th, 2011 (see attached Tetra Tech figure - Sandhill Crane Observations).

The greater sandhill crane is listed by the State of Ohio as an endangered species. The Ohio Department of Natural Resources (ODNR) considers the sandhill crane to be a species at risk from the development of wind energy facilities. The ODNR *On-shore Bird and Bat Pre- and Post-Construction Monitoring Protocol for Commercial Wind Energy Facilities in OH* (2009) provides guidance and survey protocol recommendations for the study of greater sandhill cranes within proposed wind energy facility project areas. Tetra Tech understands that prior correspondence from the ODNR did not include greater sandhill cranes as species of concern for the proposed Project Area or as part of their recommended surveys.

Given the conservation status of the sandhill crane (i.e. state listed endangered species), and the protocols explicitly recommended by ODNR for crane surveys at proposed wind projects, it is Tetra Tech's opinion that coordination with ODNR and further evaluation of sandhill crane migration is warranted within the Project Area.

TETRA TECH

Tetra Tech and JUWI believe that due to the extensive ongoing avian survey efforts being conducted in accordance with United States Fish and Wildlife Service (USFWS) and ODNR approved avian survey work plan methods, and the overall magnitude of resources already invested by JUWI for wildlife assessments within the Project Area, the ODNR survey protocols for sandhill crane would be extraneous because of the following:

1. The Project Area is not within the area identified by ODNR as requiring expanded sandhill crane migration surveys (see attached figure identified as Exhibit A Figure 2 from the ODNR guidance document);

2. A small number of cranes were seen at the proposed Project Area; and

3. The aforementioned ongoing avian survey efforts, which, although not specifically designed to monitor sandhill crane migration, are likely sufficient to do so.

Based upon the information presented above, Tetra Tech and JUWI have developed the following options for further evaluation of sandhill cranes within the Project Area:

Option 1:

Tetra Tech wildlife biologists are currently conducting Bald Eagle Point Counts on a bi-monthly basis at forty (40) point count locations within and surrounding the Project Area. Tetra Tech wildlife biologists are currently engaged in approximately 80 hours of observations monthly as part of this effort. Tetra Tech proposes the development of a species specific data collection field form that will capture information on the sandhill crane's use of the area should they be observed again. This effort and data collection will be integrated into the on-going study protocols and methodologies and reported to ODNR following completion of study efforts.

Option 2:

The ODNR monitoring protocol for sandhill cranes recommends for the extension of the diurnal bird/raptor monitoring protocol (which require day long surveys, three times weekly) from November 1st to December 15th. Tetra Tech's current on-going efforts within the Project Area on a bi-monthly basis for Bald Eagle point counts will continue through the period from November 1st through December 15th, therefore Tetra Tech proposes that wildlife biologists will incorporate species specific (i.e. sandhill cranes) data collection field forms in their survey methodology and protocols during the Bald Eagle point count weeks and then incorporate ODNR monitoring protocol recommendations (i.e. diurnal bird/raptor surveys) three times weekly during those weeks when no Bald Eagle point counts are being conducted for the time period of November 1st through December 15th.

* * * * * * * * * * * * * * * *

TETRA TECH

Tetra Tech and our client, JUWI, believe that our continued efforts (Option 1) are sufficient to monitor for potential risk associated with sandhill cranes in the Project Area. Due to the fast approaching ODNR required start date (November 1st) for sandhill crane surveys, Tetra Tech is immediately available to discuss this further with ODNR. We request confirmation from ODNR on our proposed approach, and look forward to receipt of your response no later than Friday October 21, 2011.

If you have any questions or comments concerning this letter or if there is anything else we can help you with, please contact us at (513) 564-8342 or (513) 564-8354.

Sincerely,

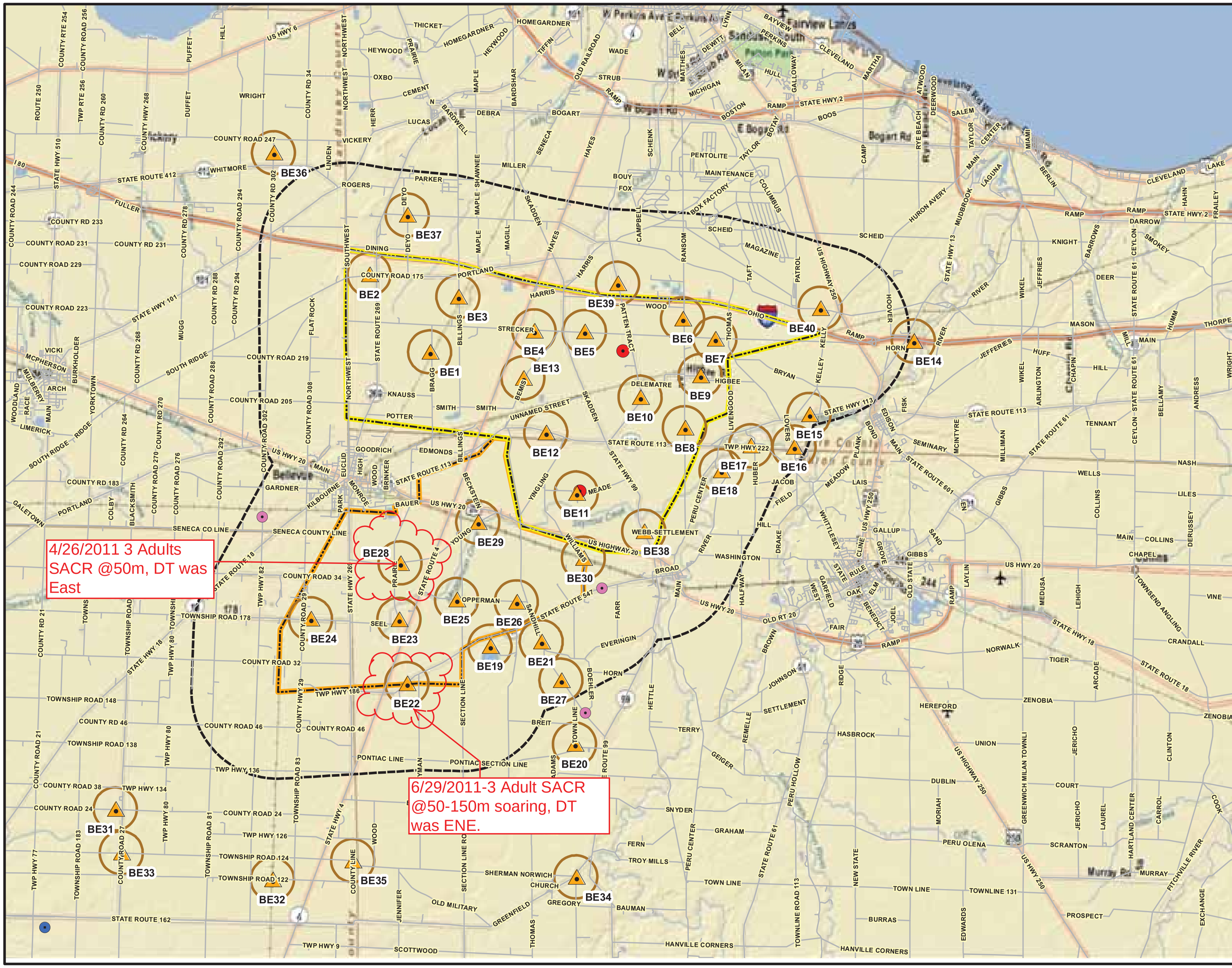
Tetra Tech

Gregory M. Kern
Wind Energy Development
Project Manager/Wildlife Biologist

Douglas J. McIlvain
Senior Project Manager

Attachments: Figure - Sandhill Crane Observations
Figure - ODNR Exhibit A - Figure 2 Sandhill Crane Counties requiring survey

Cc: Matthew Krivos, juwi Wind, LLC.



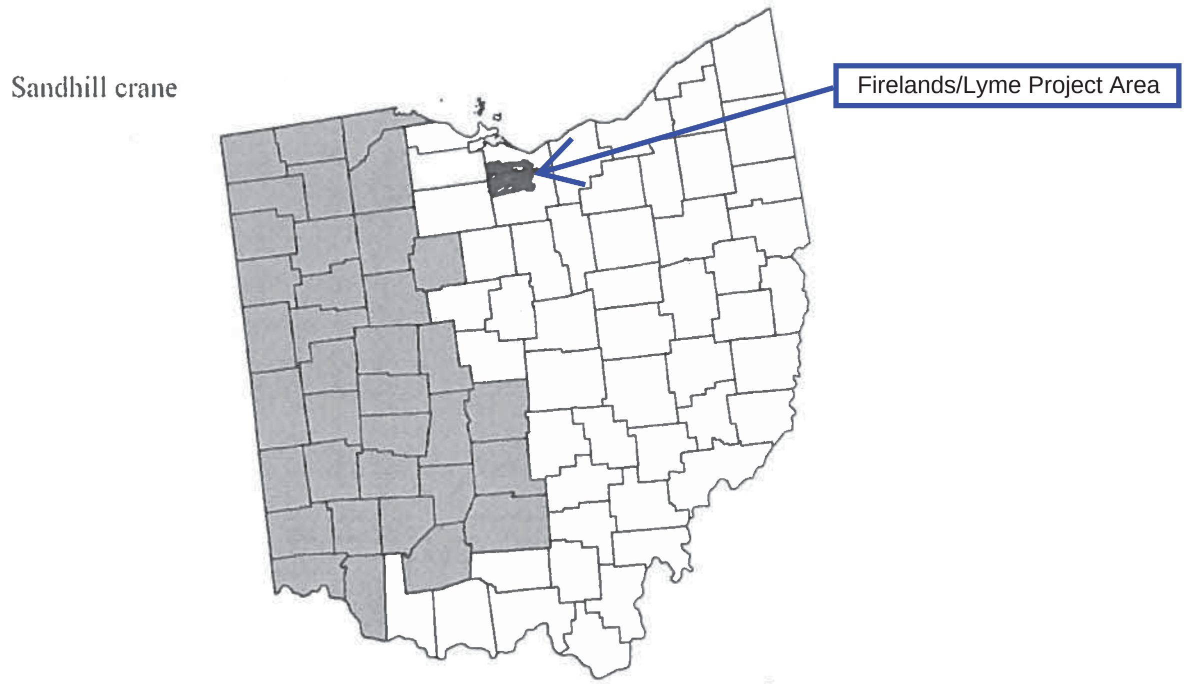
JUWI WIND
FIRELANDS AND LYME PROJECT
ERIE, HURON, AND SENECA COUNTIES, OHIO

SANDHILL CRANE OBSERVATIONS

TETRA TECH

Path: S:\CADD\MJ\JUWI\Firelands\mxd\Firelands_Lyme_Eagles_PointCountLocations.mxd Author: joel.peters Date: 7/6/2011

Figure 2. Counties or areas where additional surveying for either sandhill cranes or barn owls may be recommended.



Rodrian, Ali

From: Norris, Jennifer <Jennifer.Norris@dnr.state.oh.us>
Sent: Monday, October 24, 2011 3:36 PM
To: Kern, Greg
Cc: Krivos, Matthew C.; McIlvain, Douglas; Melanie_Cota@fws.gov
Subject: RE: Firelands-Lyme Sandhill Crane Observations

Greg,
Thank you for the opportunity to review the options you presented for the sandhill crane monitoring at juwi Wind's Firelands-Lyme proposed project. My recommendation is to follow option 2 that you presented. Option 2 includes surveying until December 15th and incorporates sandhill crane observations during the bi-monthly Bald Eagle point counts (at 40 survey locations), as well as the ODNR protocol 3 times weekly during weeks when the Bald Eagle point counts are not conducted at the 2 diurnal raptor survey locations.

I will look forward to reviewing the results of these studies. Please let me know if you have any further questions.

Thanks,
Jennifer

Jennifer L. Norris
Wildlife Research Biologist
Olentangy Wildlife Research Station
ODNR, Division of Wildlife
8589 Horseshoe Road
Ashley, OH 43003
Tel: 740 747-2525 Ext: 26
Email: jennifer.norris@dnr.state.oh.us

From: Kern, Greg [mailto:Greg.Kern@tetratech.com]
Sent: Monday, October 17, 2011 4:25 PM
To: Norris, Jennifer
Cc: Krivos, Matthew C.; McIlvain, Douglas
Subject: Firelands-Lyme Sandhill Crane Observations

Ms. Norris,

Thank you for speaking with me today regarding the incidental observations of sandhill cranes within the Firelands-Lyme Project Area. Please review the attached document and provide confirmation of our proposed approach.

Gregory M. Kern
Wind Energy Development Project Manager/Wildlife Biologist

TETRA TECH INC.
250 West Court Street, Suite 200W
Cincinnati, Ohio 45202
Office: (513) 564-8342
Cell: (513) 288-2213
Fax: (513) 241-0354
Email: greg.kern@tetratech.com

Appendix B
PHOTOGRAPHS

1	DESCRIPTION	Diurnal Site 1 looking north.

2	DESCRIPTION	Diurnal Site 1 looking northeast.

3	DESCRIPTION	Diurnal Site 1 looking east.

4	DESCRIPTION	Diurnal Site 1 looking southeast.

5	DESCRIPTION	Diurnal Site 1 looking south.

6	DESCRIPTION	Diurnal Site 1 looking southwest.

7	DESCRIPTION	Diurnal Site 1 looking west.

8	DESCRIPTION	Diurnal Site 1 looking northwest.

9	DESCRIPTION	Diurnal Site 2 looking north.

10	DESCRIPTION	Diurnal Site 2 looking northeast.

11	DESCRIPTION	Diurnal Site 2 looking east.

12	DESCRIPTION	Diurnal Site 2 looking southeast.

13	DESCRIPTION	Diurnal Site 2 looking south.

14	DESCRIPTION	Diurnal Site 2 looking southwest.

15	DESCRIPTION	Diurnal Site 2 looking west.

16	DESCRIPTION	Diurnal Site 2 looking northwest.

Appendix C

DATA SHEETS
&
DOCUMENTATION
(ENCLOSED CD)